A MODEL OF FARMERS' DECISIONS TO ADOPT THE NEW SHEEP BREEDS

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NGENANG JANGU

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This study examines the criteria used by farmers in their decisions to adopt or reject new sheep breeds. The method used Ethnographic Decision Tree Modelling to elicit decision criteria used by the decision makers when making real-world decisions.

The objectives of the research were to identify the main decision criteria or reasons for adopting the new breeds, and to identify the main decision criteria or reasons for rejecting the new breeds. Rather than using diffusion or economic models to study farmers' decision making, this research has presented an alternative approach to understand farmer's decisions from their point of view. The approach was called Ethnographic Decision Tree Modelling. Forty farmers consisting of 26 adopters and 14 non-adopters from different parts of the Canterbury Region were involved. Ethnographic interviews and participant observation were used to elicit decision criteria in order to build a decision tree. The decision tree model was also tested against an independent sample of 20 adopters and non-adopters in order to test the model's predictability.

It is concluded that ethnographic decision tree modelling can be used to elicit the main criteria used by farmers in their decisions whether to adopt or reject agricultural innovations such as new sheep breeds. These decision criteria were either specific aspects or constraints which the farmers used in the decision processes from their own perspectives. These criteria were presented in a decision tree. The results showed that those farmers who believed that the new breeds of sheep could improve the genetic merits of their stock and expect to produce financial returns and did not have the constraints of time, ram availability and its cost would adopt the breeds. Those who did not believe that the breeds could improve the genetic merits would not adopt the breeds. Other factors associated with disbelief in genetic improvement were export restrictions and health risk. Furthermore, although few farmers had indicated their belief in genetic improvement they did not adopt because of the constraints of time, ram availability and its cost. The decision model was tested and gave a predictability of 95 per cent.

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CHAPTER 1

INTRODUCTION

1.1 General Introduction

A leading New Zealand scientist in animal breeding and a team of government scientists revealed that the sheep industry in New Zealand has three shortcomings in terms of leanness, growth rates and fertility (Galloway, 1993: pers. comm.). They decided that the industry required animals that would give leanness, faster growth rate and higher fertility. McMillan *et al.* (1988) also described the genetic base of sheep in New Zealand as narrow. The industry is largely based on dual purpose breeds producing meat and wool.

In 1984, the Ministry of Agriculture and Fisheries (MAF), therefore, decided to review the need for new sheep breeds which had the desired features of leanness, faster growth rate and higher fertility. Veterinarians and scientists from MAF investigated a number of alternative overseas sources and recommended the importation of Texel, Oxford Down (Oxford) and Finnish Landrace (Finns) breeds from Denmark and Finland. The importation was, therefore, undertaken to bring to New Zealand the new genetic material in order to widen the genetic base of the national flock. The Texel was for leanness, the Oxford Down was for faster growth rate, and the Finns were introduced to improve the reproductive rate (Clarke *et al.*, 1988).

In 1985, two companies, Sheepac[1] and LambXL[2], brought the new breeds into the country in the form of embryos and semen (to minimise the risk of disease hazards). These embryos and semen were implanted into traditional ewes. The resulting progeny were placed in quarantine for about five years. They were released from quarantine in October 1990 for sale to sheep farmers.

A recent survey by MAF shows that there are about 26 per cent of Canterbury's 2,332 farmers[3] have introduced exotic sheep breeds (Finns, Texels and Oxford Downs). About 23 per cent were using Texels and 3 per cent are using Finns and Oxford Downs (Galloway, 1993: pers. comm.). The interesting question is why were there only 26 per cent of the farmers interested and 74 per cent not interested in the new breeds of sheep? This research tries to address this question by identifying the reasons or factors that influence farmers in their decisions to adopt or reject the new breeds.

1.2 Research Objectives

The aim of this study was to view the new sheep breeds through the eyes of the adopters and non-adopters of the innovations, the sheep farmers. Thus, the first objective of this research was to identify the main factors or reasons that influenced farmers in deciding to adopt the new sheep breeds. The second objective was to identify the limiting factors that influenced farmers to reject the new sheep breeds. These two objectives are important in order to assess the general reactions of the farmers towards the introduction of the new sheep breeds in the country.

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1 Sheepac: The company is 50 per cent owned by 43 leading sheep breeders in the country, and the balance of 50 per cent is owned by MAFTech.

2 LambXL: Originally the company was called the New Zealand Animal Enterprise. Later, the New Zealand Dairy Board had decided to change the name to LambXL.

3 New Zealand Department of Statistics. Agricultural Statistics 1990.

1.3 Research Approach

It has been shown that the adoption of an innovation follows a normal, bell-shaped curve when plotted over time on a frequency basis (Rogers, 1983). If the cumulative number of adopters is plotted, the result is an S-shaped curve. The study assumes that behind every S-shaped diffusion curve, or graph of percentage of farmers adopting over time, is a number of individual decisions to adopt.

Some of the factors leading to adoption of innovations mentioned in the literature are: economic profitability, compatibility and trialability (Kivlin and Fliegel, 1968; Rogers, 1983; Vanclay, 1992). Likewise some of the limiting factors mentioned in the literature in the adoption of innovations are: non-profitability (Fliegel and Kivlin, 1966; Downs and Mohr, 1979; Rogers, 1983), risk and uncertainties (Rogers, 1983; Bandura, 1986), incompatibility (Hoffer, 1958; Ramsey *et al.*, 1959; Rogers, 1983), lack of capital (Havens and Finn, 1975), and inadequacy of information (Fairgray, 1977; Greer, 1982). In this study focus is on decisions made by individual farmers to assess whether some or all or other than these factors are important.

A variety of approaches have been used to study diffusion. Some require historical data or data over time. Because these data are not available for the new sheep breeds the diffusion model cannot be used in this study. Instead, a social science research method called ethnographic decision tree modelling is used which focuses on the actual decision making processes of a small sample of farmers. Therefore, the decision was made to study adoption on the micro level, as an individual decision, so as to develop a method which could identify the constraints or critical factors in the adoption decision process. In order to predict the actual adoption choices made by individual farmers and to identify the factors or reasons limiting or inducing adoption, a model

of the decision to adopt the new sheep breeds was proposed and tested. To achieve this goal a model of decision making is developed. The form of decision model used in this research was a decision tree.

This model focused on understanding in detail why some farmers adopted or rejected the new sheep breeds. This was done by identifying the main criteria or reasons used by farmers from their own perspectives in their decision making. It also involved studying a relevant, real-world decision using a form of decision model somewhat different from those previously seen in the economics literature which tend to prescribe solutions rather than describe the actual decisions and predict choices of individuals.

1.4 Outline of Research

In the next chapter (Chapter 2) the attributes of the new sheep breeds and their potential towards the improvement of the existing sheep industry will be described. The characteristics of the conventional sheep breeds will also be reported. A theory of innovation diffusion of farm practices will be reviewed in Chapter 3. Some common decision-making models and the Ethnographic Decision Tree Model will be introduced in Chapter 4. Chapter 5 describes the method used for the research. This will include a description of the survey method, the method of data collection, and a discussion of the data processing and analysis. The results of the study will be presented in Chapter 6. Finally, Chapter 7 will present a summary of research findings, discussion and conclusions. This will also include the study limitations, and some suggestions for future research.

CHAPTER 2

FEATURES OF THE NEW SHEEP BREEDS

2.1 Introduction

This research will focus on three new sheep breeds: Finnish Landrace, Texel and Oxford Down. In this chapter, the main attributes of the conventional sheep breeds in New Zealand will be described. The chapter also reports on the history and characteristics of the new breeds. Some preliminary results from the trials carried out at the quarantine stations will also be reported. The aim of this section is to reveal some of the important attributes of the new breeds that may contribute to their adoption or rejection. Farmers' reactions towards the new breeds will be presented in Chapter 6.

2.2 The Finnish Landrace

The Finnish Landrace (Finns) is a native Landrace sheep of Northern European origin (see Figure 1). The Finns are noted for their very high litter sizes - pure ewes commonly have lamb drops of 250-300 per cent (Beatson, 1992). This gives an advantage for pure Finns compared to the existing breeds of about two lambs per ewe. Sheepac, in their publication brochure (undated), claimed that the Finnish Landrace is the most prolific breed in the world. They advocated that, probably, the Finns are too prolific in their pure state for New Zealand conditions. They indicated that the introduction into the local breeds of one eighth Finn blood would be able to give a 10-20 per cent lift in lambing. The Finns were brought in mainly for the hill-country sheep farmers to increase the lambing percentage in the rolling hill country (Galloway, 1993: pers. comm.). The lambing percentage in the hill country quite often gets below 100 per cent. The lambing

Figure 1: The Finish Landrace

percentage of the national sheep flock which was obtained in 1990 was about 98 per cent (Gretton, 1992). LambXL in their publication brochure (undated) suggest that it is most likely that a 25 per cent infusion of Finn genes will be a common use of the breed in this country. They claimed that a 25 per cent infusion could result in an increased lamb drop of 25-30 per cent and this would increase the number of sheep sold and therefore improve incomes of the farmers.

Besides having a high fecundity, Finns are also believed to have good maternal traits. The survival of lambs may, therefore, be better than the traditional breeds having litters of the same size. They also cycle for a longer season than existing breeds and, therefore, are suited to out-of-season lambing and multiple-lambing (Beatson, 1992). In terms of fleece characteristics Finn wool was slightly more bulky and had similar brightness in comparison with Romney wool (Dobbie *et al.*, 1991). Elliott (1986), quoted in Dobbie *et al.* (1991), also stated that the increased whiteness of the Finn wool would be expected to be of commercial significance.

2.3 The Oxford Down

The Oxford Down was developed in Britain from the crossing of the Hampshire Down and Cotswold breeds (see Figure 2). It is the principal down breed used in Scandinavia. LambXL, in their publication brochure (undated), claims that the Oxford Down will find an important place in the New Zealand sheep industry as a terminal sire used over the traditional long-wool breeds, such as Romney, Coopworth and Perendale. It enables earlier kills because of the faster growth rate. Sheepac, in their publication brochure, reported that the Oxford is reputed to be the largest and fastest growing of all the British breeds. It is leaner at heavier weights than other terminal sires.

Figure 2: The Oxford Down rams

They further mentioned that MAFTech trials in New Zealand with Romney and Border Leicester crosses revealed that Oxford sired lambs have GR[4] and C[5] measurements that are respectively 7.0 and 15 per cent less than Suffolk crosses, and 11 and 16 per cent less than Border Leicester crosses. They also reported that the growth rates of Oxfords are also higher. The Sheepac publication reports that UK studies showed that the Oxford Down-sired lambs grow to equivalent slaughter weights and 6.0 per cent faster than the Suffolk-sired lambs. Sheepac also noted that in New Zealand, Suffolks grow faster than most of the dual purpose breeds used here.

In New Zealand, the attribute of quick maturity in lambs is needed especially in the dry land and unirrigated areas. Some scientists believe that if the lambs are not taken out quickly the farmers will end up producing store lambs instead of prime lambs. McMillan *et al.* (1988) showed that the growth rates and weights of the Oxford cross lambs are consistently as good or better than Suffolk and other large breeds. For example, the weaning and yearling weights of the Oxford cross are about 6.0 per cent and 2.5 per cent higher than the Suffolk cross respectively. The Oxford Down has wool similar to New Zealand's Suffolk, with the wool showing a sprinkling of black on the points. However, the incidence of black fibre reputed to be much lower in Oxfords than it is in other down breeds (*New Zealand Farmer 20/12/89*).

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4 GR Measurement: Measurement of tissue depth, in mm, over 12th rib approximately 110 mm from the mid-line. It is a measurement of fat between the bone and the skin.

5 C Measurement: Measurement of fat depth, in mm, over the last rib, 40-50 mm from the mid-line.

2.4 The Texel

The Texel breed takes its name from the island of Texel in Holland (see Figure 3). Development of the breed did not occur until the beginning of this century when fertilizers, supplementary feed and the introduction of English breeds eventually led to the Texel sheep of today. The sheep have been exported to many European countries, as farmers became interested in the breed for its meat qualities and its ability to stamp these qualities on the progeny of any breed of ewe.

LambXL in their publication brochure reported that, in England, the breed has continued to grow in popularity. For example, in 1987 and 1988, the Texel dominated all the carcass competitions at the Smithfield Show in the United Kingdom. The availability of increasing numbers of Texel and Texel cross lambs has enabled English butchers to pay premiums of between NZ 30 and 40 cents per kilogram in an effort to capture sufficient product. Many butchers in the United Kingdom are now contracting farmers to provide Texel and Texel cross lambs.

New Zealand's sheep industry is largely based on dual purpose breeds producing meat and wool and Texels were introduced to increase the production of a heavy lean carcass (Dobbie *et al.*, 1991). The animal scientists revealed that fat was one of the main problems in the local sheep industry and that no work had been done in reducing fats until about 1985 when the scientist began to think about it (Galloway, 1993: pers.comm.). It was also reported that one of the biggest faults of meat has been its overfatness and poor muscling (*New Zealand Farmer 17/10/90*). There is a genetic barrier in traditional New Zealand sheep breeds' base genes which leads to lambs coming in at about 16 kg for a ewe and 19 kg for a ram. Once those weights are achieved, the lambs normally incur penalty rates at the works for being too fat (*New Zealand Farmer 17/10/90*). Texels are renowned for their extreme leanness and superior muscling. By introducing

Figure 3: A Texel ram

Texels it is hoped to lower this genetic barrier and address the problems of overfatness and muscling.

LambXL also emphasised that the Texel breed is renowned for its magnificent muscling and outstanding leanness. When used as a terminal sire for the traditional breeding ewes, they claim that there will be significant advantages over the traditional lambs. LambXL also claims that the other advantages of using Texels will include: (1) a higher killing out-percentage, (2) a larger eye muscle area or a better muscling in the hindquarters, (3) low fat percentages compared to other sires and (4) superior carcass conformation with blockier and leaner legs and shoulders.

Sheepac, also reported similar attributes about Texels. They reported that when used as a terminal sire this will allow carcass weights to be at least three kilograms heavier at the same GR measurement as the traditional flocks. They revealed that with existing breeds only about 25-30 per cent of ram lambs of 20 kg carcass weight have a GR of less that 12 mm. About 85 per cent of Texel sired carcasses will have a GR under 12 mm. Results from trials done by MAF shows that Texel cross lambs have lower GR depths at any carcass weight compared to Oxford, Border Leicester and Suffolks (Beatson, 1992). Beatson also revealed that Texel cross lambs are 1.5 kg heavier than Suffolk at the same GR.

Sheepac also reported that the carcasses have very low levels of fat for their weight, have an excellent meat to bone ratio, large eye muscles and well muscled hind legs. Ultrasonic measurements of fat depths at shoulders, loin and leg of Texel cross shows that they were 31 per cent less than Suffolk crosses (Clarke and Kirton, 1990). They also showed that in the loin, Texel crosses had 12 per cent and 8 per cent less subcutaneous fat and intermuscular fat respectively than Suffolk crosses. Texel crosses were also about 5.0 per cent more lean than Suffolk crosses.

With these attributes, agricultural consultants from Sheepac argued that the Texel will have a great potential to play in the New Zealand meat industry. They mentioned that farmers were expected to derive a substantial benefits from using the new breed in their commercial flock. For example, the Texel produces lean meat with a large eye-muscle which is in great demand by supermarkets throughout the United States and Europe (*New Zealand Farmer 17/10/90*).

The other benefit from the Texel, as reported in the LambXL and Sheepac brochures, is the bulk in the wool. The Texel breed has a fleece production of 3.5-4.0 kg per annum. The wool is white, with a fibre diameter of 27-30 micron, similar to the Cheviot breed, but has a higher bulk measurement. Wool buyers have stated that they want more bulk in the New Zealand wool clip (Galloway, 1993: pers. comm.). It is anticipated that once significant volumes are available, this will command premiums within the carpet trade. This highly heritable bulking characteristic is one that is sought after commercially, particularly in Europe and Japan where a niche exists in the futon bed and wool overlay markets (*New Zealand Farmer 20/12/89*).

2.5 Conclusion

In this chapter the characteristics of the conventional sheep breeds in New Zealand have been described. The attributes of the three new breeds of sheep the Finnish Landrace, Oxford Downs and Texels have also been reported. The scientists and the sheep promoters believe that the sheep industry in the country lack three main attributes: leanness, growth rate and fertility. They believe that the new breeds have the genetic material to widen the genetic base of the national flock and overcome these deficiencies. The Finnish Landrace have a high fertility rate and are recommended for the hill-country sheep farmers to increase the lambing percentage in the rolling hill country. The Oxford Downs have faster growth rates and recommended for use in dry land

areas so that farmers can finish the lambs much earlier. Texels can contribute leanness, big eye muscle and muscling of the hind legs and are recommended to address the problems of overfatness and poor muscling commonly found among the local breeds.

The scientists have pointed out the shortcomings of the existing sheep industry and identified the alternative breeds to overcome these problems. However, not all farmers have shown a positive response towards the new breeds. Some have expressed their reservations and decided to reject them. To understand the farmers' reactions to adopt or reject the new innovations there is a need, first, to study some aspects of diffusion and the decision making process made by farmers. A theory on the diffusion of innovation will be presented in Chapter 3. A decision model which will be used to study farmers' decision making will be described in Chapter 4.

CHAPTER 3

THEORY OF INNOVATION DIFFUSION

3.1 Introduction

The adoption of innovations has been the subject of extensive research over the past 30 years or so. One of the most influential models in the innovation diffusion tradition was that developed by Rogers and called Rogers's Adoption Process (Rogers, 1962). Clark and Staunton (1989) described it as a centre-periphery model of diffusion. Rogers (1983) revised the model and called it the Innovation-Decision Process in his publication of the third edition of *Diffusion of Innovation.*

This chapter introduces Rogers's Diffusion Model in relation to the innovation-decision process, adopter categories and factors influencing the rate of adoptions. Some criticisms of Rogers's Model will also be described in this chapter.

3.2 Diffusion of Innovation

An innovation is an idea, practice or object that is perceived as new by an individual or other unit of adoption (Rogers, 1983). The focal point is the perception of the idea. An idea which seems new to an individual is an innovation. The adoption of an innovation is a decision to make full use of a new idea as the best course of action available (Rogers and Shoemaker, 1971). The diffusion of innovations is defined as the process by which an innovation is communicated through certain channels, over time, among the members of a social system (Rogers, 1983).

3.2.1 Innovation-Decision Process

The main features of Rogers's Model are the process of innovation-decision, the concept of innovations to classify the adopters and the factors that determine the rate of adoption. In his revision of the earlier model Rogers developed a 5-stage Innovation-Decision Process and explained it in this way:

> "The Innovation-Decision Process is the process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude toward the innovation, to a decision to adopt or reject, to implementation of the new idea, and to confirmation of this decision." (Rogers, 1983: 163)

This process comprises of a series of actions and choices over time through which an individual evaluates a new idea and decides whether or not to introduce the new idea into the existing practice. It has five stages: (1) knowledge, (2) persuasion, (3) decision, (4) implementation, and (5) confirmation.

At the knowledge stage, the individual is exposed to the innovation's existence and gains some understanding of how it functions. There are three types of knowledge about an innovation. Awareness-knowledge motivates an individual to seek "how-to" knowledge and "principles" knowledge before he or she considers the knowledge. How-to-knowledge consists of information necessary to use an innovation properly, and the principles knowledge consists of information which concerns the functioning principles of how the innovation works. Rogers then makes seven generalizations about the early knowers of innovations in relation to later knowers: (1) they have more education, (2) they have higher social status, (3) they have more exposure to mass media channels of communication, (4) they have more exposure to interpersonal channels of communications, (5) they have more change agent contact, (6) they have more social

participation, and (7) they are more cosmopolite.

At the persuasion stage the individual then forms a favourable or unfavourable attitude toward the innovation. In developing a favourable or unfavourable attitude toward the innovation, an individual may mentally apply the innovation to his or her present or anticipated future situation before deciding whether or not to try it.

At the decision stage the individual becomes involved in activities that lead to a choice to adopt or reject the innovation. According to Rogers, most individuals will not adopt an innovation without trying it first on temporary basis to determine its usefulness in their own situation. They will decide to adopt if it has a certain degree of relative advantage. Similarly, rejection of an innovation by individuals can occur at the knowledge, persuasion and decision stage. Eveland (1979), quoted in Rogers (1983), describes two types of innovation rejections: (1) active rejection, which consists of considering adoption of the innovation but then deciding not to adopt, and (2) passive rejection, which consists of never really considering the use of the innovation.

At the implementation stage an individual puts an innovation into use. A certain degree of uncertainty about the expected consequences of the innovation exist. So active information seeking takes place at the implementation stage. The stage continues for a lengthy period of time, depending on the nature of the innovation. The point is reached at which the new idea becomes an institutionalized and regularized part of the adopter's ongoing operations.

At the confirmation stage the individual seeks reinforcement for a decision already made. An individual may reverse the decision if exposed to conflicting messages about the new idea. The stage continues after the decision to adopt or reject for an indefinite period in time. Throughout

this stage the individual seeks to avoid a state of dissonance or to reduce it if it occurs. Rogers describes this rejection process as discontinuance which consists of two types: (1) replacement, which is a decision to reject an idea in order to adopt a better idea that supersedes it, and (2) disenchantment, which is a decision to reject an idea as a result of dissatisfaction with its performance. Rogers then makes two generalizations regarding discontinuance process: (1) later adopters are more likely to discontinue innovations than are earlier adopters, and (2) innovations with a high rate of adoption have a low rate of discontinuance.

3.2.2 Adopter Categories

In a social system, different individuals adopt an innovation at different times. That is, they adopt in a time sequence (Rogers and Shoemaker, 1962; Rogers, 1983). The adoption of an innovation follows a normal, bell-shaped curve when plotted over time on a frequency basis, and if the cumulative number of adopters is plotted, the result is an S-shaped diffusion curve (Figure 4). Rogers developed the concept of innovativeness (the degree to which an individual is relatively earlier in adopting new ideas than other members of a social system) to classify individuals in a social system into five adopter categories: innovators, early adopters, early majority, late majority and laggards (Figure 5). These five categories are ideal types and are conceptualizations based on observations of reality and designed to make comparisons possible.

Rogers identified dominant attributes of each category, these being innovators - venturesome; early adopters - respectable; early majority - deliberate; late majority - sceptical; and laggards - traditional. Rogers then makes a series of generalizations on the characteristics of the earlier adopters against the later adopters in terms of socioeconomic status, personality variables and communication behaviour.

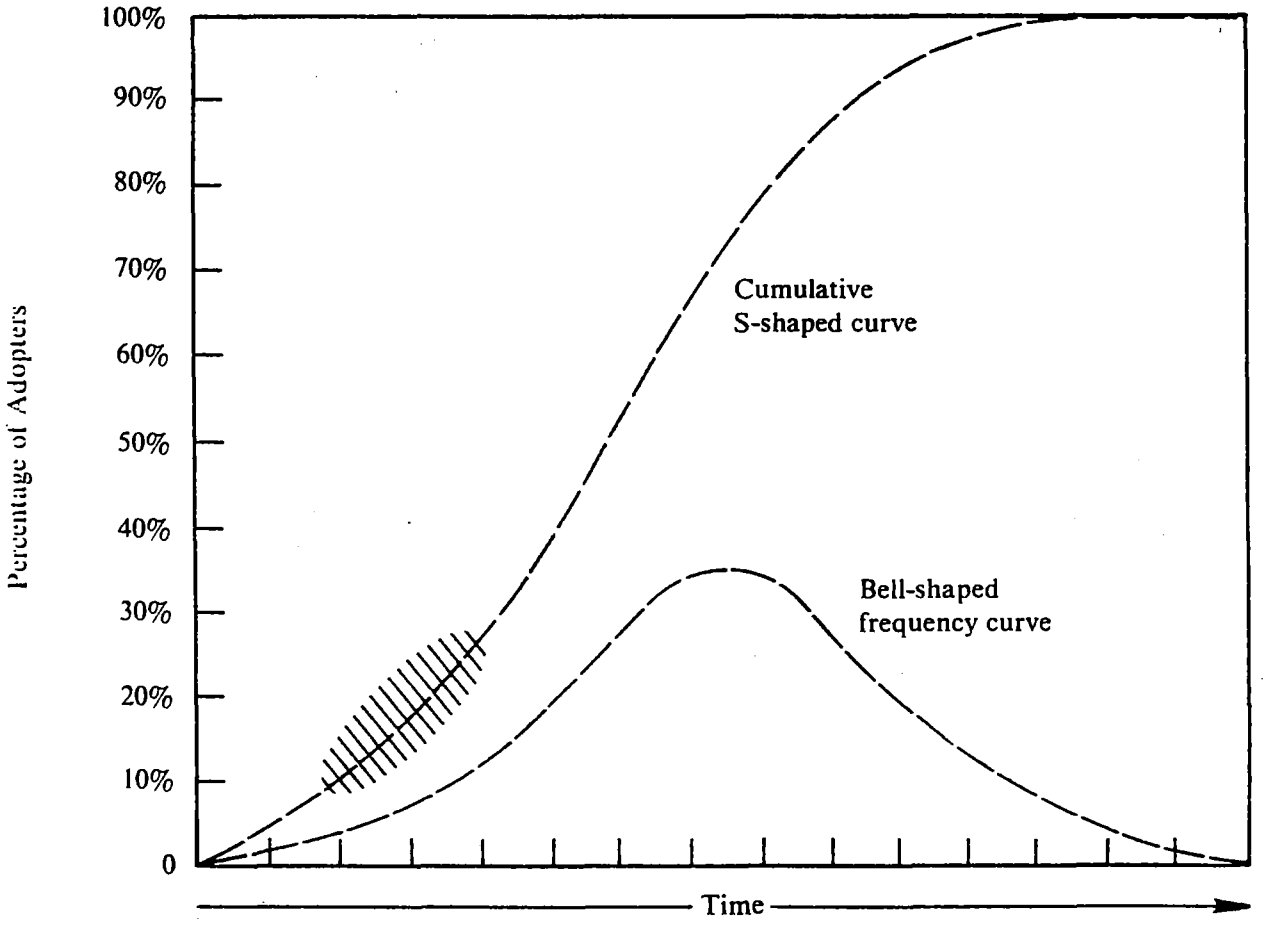

Figure 4: **The Bell-shaped Frequency Curve and the S-shaped Cumulative Curve for an Adopter Distribution**
(Source: Rogers, 1983)

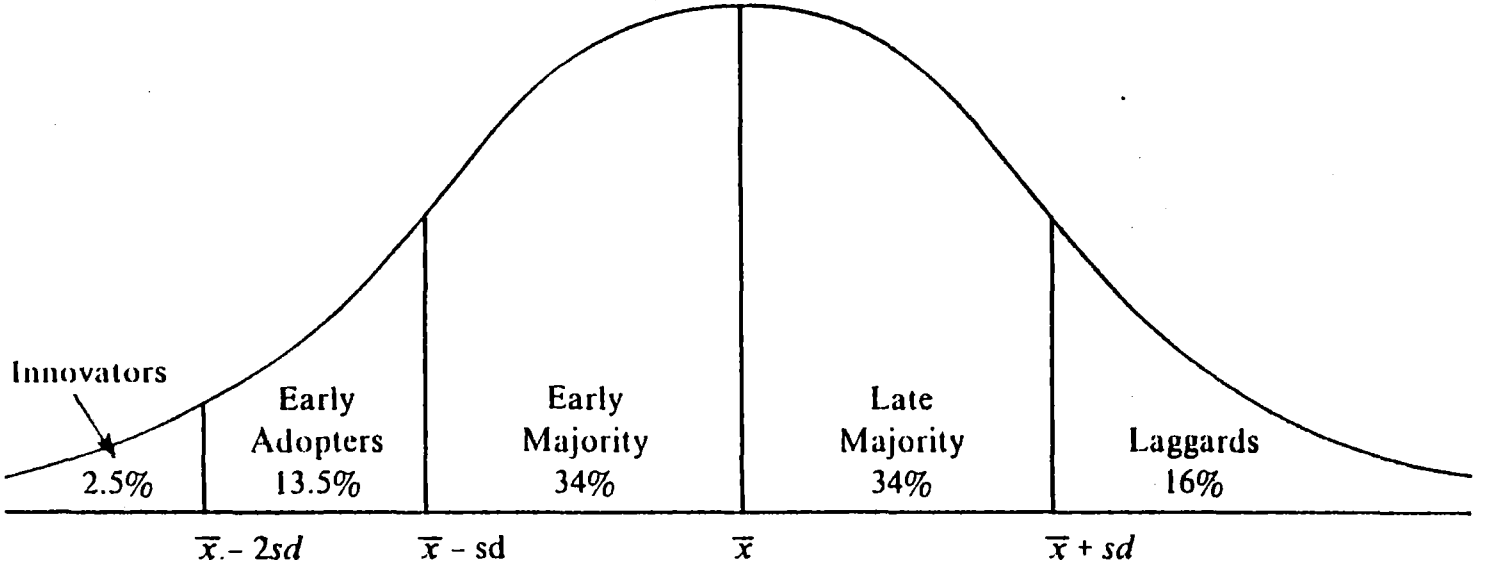

Figure 5: **Adopter Categorization on the basis of Innovativeness (Source: Rogers, 1983)**

The generalizations concerning socio-economic status and innovativeness are listed as follows: (1) earlier adopters are not different from later adopters in age, (2) earlier adopters have more years of education than later adopters have, (3) earlier adopters are more likely to be literate than are later adopters, (4) earlier adopters have higher social status than later adopters, (5) earlier adopters have a greater degree of upward social mobility than later adopters, (6) earlier adopters have larger-sized units (farms, companies, and so on) than later adopters, (7) earlier adopters are more likely to have a commercial (rather than a subsistence) economic orientation than are later adopters, (8) earlier adopters have a more favourable attitude toward credit than later adopters, and (9) earlier adopters have more specialized operations than later adopters.

The generalizations concerning personality variables associated with innovativeness are: (1) earlier adopters have greater empathy than later adopters, (2) earlier adopters may be less dogmatic than later adopters, (3) earlier adopters have a greater ability to deal with abstractions than later adopters, (4) earlier adopters have greater rationality than later adopters, (5) earlier adopters have greater intelligence than later adopters, (6) earlier adopters have a more favourable attitude toward change than later adopters, (7) earlier adopters are more able to cope with uncertainty and risk than later adopters, (8) earlier adopters have a more favourable attitude toward education than later adopters, (9) earlier adopters have a more favourable attitude toward science than later adopters, (10) earlier adopters are less fatalistic than later adopters, (11) earlier adopters have higher levels of achievement motivation than later adopters and (12) earlier adopters have higher aspirations (for education, occupations, and so on) than later adopters.

The generalizations regarding communication behaviour in relation to innovativeness are: (1) earlier adopters have more social participation than later adopters, (2) earlier adopters are more highly interconnected in the social system than later adopters, (3) earlier adopters are more

cosmopolite than later adopters, (4) earlier adopters have more change agent contact than later adopters, (5) earlier adopters have greater exposure to mass media communication channels than later adopters, (6) earlier adopters have greater exposure to interpersonal communication channels than later adopters, (7) earlier adopters seek information about innovations more actively than later adopters, (8) earlier adopters have greater knowledge of innovations than later adopters, (9) earlier adopters have a higher degree of opinion leadership than later adopters and (10) earlier adopters are more likely to belong to highly interconnected systems than are later adopters.

3.2.3 Factors Influencing Rate of Adoption

As well as describing the characteristics of different types of adopters, Rogers identifies five variables that influence the rate of adoption of an innovation. One important type of variable is the perceived attributes of innovations. In addition to these perceived attributes other variables would include (1) the type of innovation-decision, (2) the nature of communication channels diffusing the innovation, (3) the nature of the social system, and (4) the extent of change agents' promotion efforts in diffusing the innovation.

Fliegel and Kivlin (1966), presented detailed list of attributes of innovations as factors influencing adoption. Many of these attributes are included in Rogers's new list of the perceived attributes of innovations. These perceived attributes are:

* Relative advantage
* Compatibility
* Complexity
* Trialability and
* Observability.

Relative Advantage: This is described as the degree to which an innovation is perceived as being better than the idea it supersedes. The following factors can be used to assess the relative advantage of an innovation: (1) economic profitability, (2) lower perceived risk, (3) savings in time and effort, (4) a decrease in discomfort, and (5) immediacy of the reward.

Compatibility: This is described as the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters. An idea that is more compatible is less uncertain to the potential adopter. An innovation can be compatible or incompatible with: (1) socio-cultural values and beliefs, (2) previously introduced ideas, and (3) client needs for innovation.

The importance of an innovation being compatible with the needs of receivers was shown by Kivlin and Fliegel (1968). In their study on the perceptions of new practices by dairy farmers in Pennsylvania, they found that middle-scale dairy farmers and small-scale dairy farmers had different perceptions of an innovation. Middle-scale farmers seemed to adopt innovations which had long-run financial implications. They accepted relatively quickly those practices which they perceived as conserving their own time and physical effort. They also seemed to resist practices which they perceived to involve pressure to organize their business. On the other hand, small-scale dairy farmers were relatively more willing to accept practices which required more time and effort and which they perceived to yield short-run profit.

Kivlin and Fliegel (1968) conclude:

> "The manner in which he or she (the farmer) relates to his or her business, may be at least as important as particularistic perceptions and stimuli in explaining some of his or her later behaviour (adoption)." (p.140)

An innovation which is not compatible to the previously introduced ideas will reduce the rate of adoption. As quoted by Rogers (1983):

> "Old ideas are the main tools with which new ideas are assessed. One cannot deal with an innovation except on the basis of the familiar and the old fashioned. Previous practice is a familiar standard against which the innovation can be interpreted, thus decreasing uncertainty." (p.224)

Complexity: This refers to the degree to which an innovation is perceived as relatively difficult to understand and use. Some innovations are clear in their meaning to potential adopters while others are not. In general, the research evidence suggests that, "the complexity of an innovation, as perceived by members of a social system, is negatively related to its rate of adoption" (Rogers, 1983). Indeed, some research evidence (see for example, Singh, 1966: and Petrini, 1966), quoted in Rogers (1983), indicates that with highly complex farm innovations, this was the most important factor limiting their adoption.

Trialability: This is the degree to which an innovation may be experimented with on a limited basis. New ideas that can be tried will generally be adopted more quickly than innovations that are not divisible. In general, research evidence indicates that, "the trialability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983; Fliegel and Kivlin, 1966; Singh, 1966).

Observability: This refers to the degree to which the results of an innovation are visible to others. The results of some ideas are easily observed and communicated to others, whereas some innovations are difficult to describe to others. Extension research suggests that, "the observability of an innovation, as perceived by members of a social system, is positively related to its rate of adoption" (Rogers, 1983).

3.3 Criticisms of Rogers's Diffusion Model

Rogers's diffusion model has been very influential in the United States in relation to the implementation of both internal and overseas development policy (Clark and Staunton, 1989). However, despite this success a number of problems with the model have been identified. These are (1) the concept of innovativeness, (2) the acceptance versus the availability, and (3) the tendency toward pro-innovation bias.

The first problem lies in Rogers's generation of the categories of adopters ranging from innovators to laggards using the concept of innovativeness. Clark and Staunton argue that this concept is very ambiguous and the evidence presented by Rogers to prove the actual existence of the ideal type categories was very limited.

Second, the model assumes that innovations spread through time and space as part of a process of information dissemination. The spread of information is seen to be even, comprehensive, and to adopt is always the best course of action. Clark and Staunton argue that not all individuals have equal access to information and innovations. If the innovations were not available then this would influence the rate of adoption of innovations by the individuals.

The third problem is the question of pro-innovation bias. The model states that an innovation should be diffused and adopted by all members in a social system. It should be diffused rapidly and should not be modified or rejected. The decision to adopt is seen positively, and the decision to reject is seen negatively and regarded as resistances to innovation. Clark and Staunton viewed this as a kind of technological fix which refers to overdependence on technological innovation to solve complicated social problems. They argued that this change is uncritically linked with

improvement. They argue that the implication from Rogers's model is that innovation is synonymous with modernity and progress, and conversely failure to innovate is associated with backwardness.

In addition to the above problems, another problem with Rogers's model of diffusion is concerning the diffusion of innovation from progressive to less progressive farmers. In the acceptance of innovation, it has been inferred that a psychological trait is involved which has been variously called progressiveness, innovativeness, venturesomeness or a willingness to take risks (Fliegel, 1984). It has led to the progressive farmer strategy, also called the trickle down approach, which assumes that innovations can be disseminated to less progressive farmers through the progressive farmers who have adopted the innovations earlier (Röling, 1984: quoted in Arnon 1989).

However, some authors question the validity of this progressive farmer approach. Galjart (1971), from his studies of the smallholder farmers in Brazil identified sociological factors that impede the development of agriculture. He classified these factors into three categories:

(1) Ignorance: the farmer does not know what he can do other than what he is currently doing.
(2) Inability: the farmer knows what he could do but is unable to do it for financial or other reasons.
(3) Unwillingness: the farmer knows what he should do and can do it, but does not want to; certain values and attitudes prevent him.

Havens and Flinn (1975) showed that smallholder farmers were not able to adopt the new improved coffee variety because they were unable to obtain credit and to wait for three years for

the plants to come into production and not because they were passive or resistant to the new idea. It has also been noted that subsistence farmers were also not able to take risks because they have limited access to information (Arnon, 1989).

Similarly, Arnon (1987), from his observations as a consultant on agricultural research in a number of least developed countries (LDCs) in Asia, Africa, and Latin America stated:

> "Unfortunately, it is in the Third World countries that the diffusion of innovations does not, as a rule, follow the pattern implied in the progressive farmers' strategy. In these countries, the village community consists generally of a minority who are able to adopt an innovation, and need only to be made aware of its potential benefits and a vast majority of small farmers who lack the means needed to make adoption possible. Even after the progressive and richer farmers in their area have adopted a new practice, they do not follow suit. Instead of a minority of laggards, there is a majority who are non-adopters, not by choice, but by force of circumstances." (p.293)

Röling (1982), in summing up the experience of agricultural extension in LDCs, expressed the same thought in even stronger terms:

> "In rural communities that are very differentiated in terms of access, it is nonsensical to expect innovations to diffuse from high-access farmers to low-access ones. In general, innovations will only diffuse within groups of people who are homogenous in access." (Quoted in Arnon, 1987:p.293)

McAlister (1981), argued that it can be even counterproductive to introduce innovations through the most innovative farmer in a community. He showed that in order to maintain the existing social status and to get the economic advantage from the innovation, the earlier adopter tends to withhold, delay or distort the information.

3.4 Conclusion

In this chapter Rogers's theory of diffusion has been described. Rogers has introduced the three main features of the innovation-decision process: the process of innovation-decision, the concept of innovativeness to classify the adopters and the factors that determine the rate of adoption. According to Rogers, the innovation-decision process consists of a series of actions and choices over time through which an individual evaluates whether or not to adopt the new idea. Not all individuals in a social system adopt an innovation at the same time. The adoption of an innovation is a continuous process over time and follows a normal, bell-shaped curve or S-shaped diffusion (cumulative) curve. Rogers then produced the five categories of adopters namely, innovators, early adopters, early majority, late majority and laggards based on their degree of innovativeness. Rogers also identified the main variables and the attributes of innovation which influence their rate of adoption of innovation. He later describes a series of generalizations about the earlier adopters concerning innovation, and also the relationship of the attributes of innovations and their rate of adoption. As stated in Chapter 1, the main objective of this research is to identify the main reasons why farmers have decided either to adopt or reject the new breeds of sheep. The question is: are all these elements of diffusion theory as described by Rogers relevant in Canterbury farmers' decisions to adopt new sheep breeds?

Some researchers have raised some problems and criticisms about the diffusion model. For example, Clark and Staunton (1989) had raised some doubts about the concept of innovativeness, the acceptance versus the availability of innovation, and the tendency towards pro-innovation bias. Similarly, it was argued from developing world experience that it was not valid to suggest that innovations can be disseminated through progressive farmers who will then transfer these innovations to less progressive farmers (McAlister, 1981; Röling, 1982; Arnon, 1987). The other

problem with the diffusion model is that non-adopters are treated as passive and resistant to change or to acceptance of the new idea. However, Galjart (1971) and Havens and Flinn (1975) showed that some farmers were not able to adopt the new idea not because they were resistant to change but because they did not have the means, such as credit, to adopt.

There are reasons to believe that the diffusion model has some shortcomings in trying to explain farmers' behaviour in their actual decisions whether or not to adopt the innovations. Therefore, in this study, an alternative approach called the Ethnographic Decision Tree Model as developed by Gladwin (1989a) will be used to investigate farmers' decision making on whether or not to adopt the new sheep breeds. This model will be presented in Chapter 4. However, before introducing this model the chapter will describe some of the common decision models which have been used by various authors in explaining the decision making process.

CHAPTER 4

ETHNOGRAPHIC DECISION TREE MODELLING

4.1 Introduction

Chapter 3 highlighted the main features of Rogers's diffusion model: the process of innovation-decision, the concept of innovativeness to classify the adopters, and the factors that determine the rate of adoption. A few researchers have raised some problems and criticisms about the diffusion model. Therefore, there is a need to look at decision-making itself which is more fundamental. One aspect of decision-making is whether or not to adopt a new agricultural innovation. This chapter describes an alternative method used to understand farmers' decision making. This method is called Ethnographic Decision Tree Modelling. The chapter begins by introducing some of the common decision-making models and describing their elements of operation, and their advantages and disadvantages. This will be followed by presenting a cognitive approach to decision making that will be used in this research.

4.2 Farmers' Decision Making

Dillon (1971), quoted in Lewis (1981), carried out an extensive review article on modern decision theory (also known as Bernoullian decision theory). The theory is considered as a systematic approach to decision making. It assumes an economic man who is rational, has considerable knowledge, a well organised and stable system of ordered preferences (goal) and chooses to maximise something (utility etc.). The decision maker is also assumed to be consistent and logical. Dillon also describes Bernoullian decision theory (expected utility model) as a normative approach to risky choice based upon the decision maker's personal strengths of belief (or

subjective probabilities) about the occurrence of uncertain events and personal valuation (or utility) of potential consequences. Given a decision maker whose preferences are consistent with the axioms of ordering, continuity and independence, there exists a function U called a utility function, which associates a single real number or utility index with any risky prospect faced by the decision maker. Bernoulli's principle thus provides a mechanism for ranking risky prospects in order of preference, the most preferred prospect being the one with the highest expected utility.

Brase and La Due (1989) in their review of factors influencing farmers' investment behaviour observe in the literature that researchers have approached the issue from two general perspectives (1) economic perspective (micro and macro) and (2) socio-economic perspective. Economic models of investment behaviour make use of mathematical equations using price and other variables in order to predict the behaviour of decision makers under a number of circumstances. The distinction between the micro and macro perspectives is the level of aggregation. The micro-economic perspective focuses on the investment behaviour of the individual farmer; the macro-economic perspective focuses on some aggregation of farmers (i.e., state or nation). The socio-economic perspective integrates economic variables with sociological and psychological factors in farmers' decision behaviour. It is less mathematical in design and is frequently specific as a list of the variables believed to influence investment. Some of the non-economic variables would include age, education, farming experience, form of ownership, farm size and so on.

Bryant and Johnston (1992) propose another perspective on decision making and describe three decision-making models: (1) the rationalist approach, (2) the disjointed-incrementalist approach, and (3) the mixed-scanning approach. The features of these approaches and their importance in decision making are described as follows.

4.2.1 Rationalist-Approach

In this model a decision maker is thought to carry out a comprehensive and exhaustive analysis of the problem. The decision maker then identifies and assesses the widest possible range of ways of addressing the problem. Finally, he or she identifies the best solution to the problem according to the defined set of goals and objectives.

Alexander (1992) describes this approach as rational problem solving consisting of a number of stages that link ideas to action. The idea may be the perception of a problem, the setting of objectives and goals, or the identification of an unused resource or opportunity. These stages include: (1) designing the problem and articulating objectives and goals; (2) designing alternative problem solutions, strategies, or courses of action; (3) projecting the likely outcomes of these alternatives, and (4) evaluating them in the light of goal-related criteria.

However, there are critics of the rational approach. Braybrook and Lindblom (1963), quoted in Bryant and Johnston (1992), argue that the model fails both as a normative model and a descriptive model. The requirements of the model are beyond the capacities of decision-makers and information is often incomplete. The costs of exhaustive information collections are prohibitive. Similarly, Simon (1957) quoted in Alexander (1992), also suggests that no real decision-making process can meet the demands of rationality which requires complete information and consideration of all possible alternatives. According to Simon, people normally "satisfice": they identify and consider options one at a time. Simon also argues that using the rational model to search through an infinite set of possible alternatives is an endless process. He says that there is no guarantee that a solution will be worked out that will achieve the predetermined goals. However, the rational model does provide a useful conceptual yardstick against which to assess

decision-making.

4.2.2 Disjointed-Incrementalist Approach

The disjointed-incrementalist approach to decision-making centres on policies that are incrementally different from existing policies. Typically, only a small number of policy options and their consequences are considered. The problem identified is continually reassessed. Similarly, the goals, objectives and strategies are readjusted. This decision approach is related to a management-type decision. Lindblom (1959) suggests that this model is a more realistic description of decision making by individuals and organizations. It also provides a more feasible and desirable approach to complex problems.

4.2.3 Mixed-Scanning Approach

The mixed scanning approach is essentially a combinations of elements of both of the above approaches. The approach consists of two steps: (1) problem identification and assessment, and (2) examination of options. In the first step, once a problem has been defined, a general assessment of the entire situation is worked out. There is little detailed information collected. Only a comprehensive listing of options is undertaken. The second step involves close, detailed examination of a small number of promising options. For example, let us assume that a farmer wants to increase farm income. Using the mixed-scanning approach, the first step the farmer does is prepare a list of all the possible ways to increase farm income which would be compatible with his or her goals. The next thing is to narrow the possible options to a workable number. The number considered will depend on the time and resources available. Detailed information is then collected and analyzed.

4.2.4 Cognitive Approaches to Modelling

Gladwin (1989a) in her study of agricultural decision making proposes a cognitive[6] approach which better reflects actual decision making. She explicitly rejects the traditional quantitative models which emanate from the economics literature which she argues are linear-additive models and often normative (e.g., linear programming models, expected-value and expected utility models, stochastic dominance models) and are not empirically grounded. Gladwin explains that these models are not usually tested against a set of choice data to see how well they predict the choices of individuals in a group. Instead, they are used either as behaviourial assumptions in a model of aggregate supply or demand or as normative models to tell people how they should make decisions.

Gladwin's major argument is that people make decisions by comparing alternatives, not by ranking options. They use decision criteria with discrete yes or no outcomes. Gladwin (1979b), in her study of farmers' adoption decisions, states that her theory of decision making assumes that people in choosing one alternative over other available alternatives, do not make complex calculations of the overall utility of each alternative. They use procedures which simplify their decision making calculations. The theory assumes that an alternative is a set of aspects or attributes or factors. It posits that, when faced with a large set of alternatives, people narrow down the set by eliminating alternatives which do not have some aspect or attribute desired by the decision maker. According to Gladwin the initial process is called the Stage 1 decision process. Once the alternatives are reduced to a manageable number, the decision maker then lists or considers all aspects or attributes of the remaining alternatives (Stage 2). He or she will then eliminate aspects on which alternatives have equal or equivalent values.

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6 Cognition(n): The mental ability by which an individual is aware of and knows about his or her environment, including such processes as perceiving, remembering, reasoning, judging, and problem solving. (Source: Morris 1992.)

When the decision maker is given a manageable number of both alternatives and aspects of the alternatives, he or she selects one of the aspects to order the alternatives. The decision maker then formulates the constraints from the remaining aspects, and passes the ordered alternatives through the constraints. If the alternative ordered first does not pass all the constraints, the alternative ordered second gets a chance at them. If no alternative passes all the constraints, another strategy is used. Therefore, according to Gladwin, the "hard-core" choice process is algebraic, since there is an ordering of alternatives on an aspect rather than maximization of that aspect. Therefore, the process may be represented by an algorithm, a decision tree, or a set of decision rules. Gladwin mentions that the decision process is also assumed to be deterministic rather than probabilistic. That is, an alternative either passes the criteria or constraints with a probability of one or it does not. There are thus no probabilities - other than 1 or 0 - facing the individual on each branch of the decision tree. An example of the cognitive approach to decision making is the ethnographic decision tree modelling. This method will be presented in the succeeding section.

The relevance of each of the above model, therefore, depends on the use to which it is to be put. An economist might find that the rational model is more appropriate and useful particularly if the variables to be analyzed are readily measurable. The disjointed-incrementalist model might be useful in the studies of satisficing behaviour, as opposed to maximising behaviour, since it readily accommodates the notion of inertia in farm structures. The mixed-scanning approach might be useful to a farmer seeking to increase farm revenues. The models essentially assume an economic man who is rational, has considerable knowledge, a well organized and stable system of ordered preferences and chooses to maximize something (utility etc.). However, doubts exist due to the apparent complexity of these models, and their comprehension by decision makers, and whether or not the extra benefits of using a more systematic approach will exceed the extra effort required. The reasoning is based on the practicalities and also on the routine nature of much of

decision making situations. For example, Lewis and Thiele (1981), in a review of literature on decision making, expressed reservations about the validity of these models to approximate the decision making in practice and also their uses in the actual practice at the farm level. From their extensive literature review, they concluded that there is little evidence of their use at the farm level. A similar extensive review by Walker and Nelson (1977), quoted in Lewis and Thiele (1981), also concluded that there is a large "gap" between theory and practice at the farm level. Conrath (1973), quoted in Lewis and Thiele (1981), also observed that decision makers in business are more prone to look for simple models to guide their judgements rather than complex choice models. Therefore, in view of the complexities of these models which farmers do not normally use in their real-life decision making, an alternative approach is used in this research to study farmers' decision making. This is called a cognitive approach to modelling. An example of this approach is the Ethnographic Decision Tree Modelling which will be presented in the next section.

4.3 Ethnographic Decision Tree Modelling

Gladwin (1989b) introduces a comprehensive approach which is used to develop indigenous knowledge systems and decision tree models. The ethnographic decision tree model assumes that the decision makers are the experts in their decision making. The model consists of two main characteristics. First, it uses and relies on ethnographic interviewing and participant observation to elicit the specific decision criteria used by the decision makers when making a real-world decision. Second, the criteria are combined in the form of a decision tree, table, flow chart, or set of "if-then rules" or "expert systems".

Gladwin argues that one of the advantages of the ethnographic decision tree modelling, in contrast to linear additive models, is that it produces more realistic assumptions about individuals' cognitive capabilities. By making use of the ethnographic eliciting techniques to specify decision criteria, unrealistic behaviourial assumptions and armchair propositions about how people in the real world making important decisions can then be avoided. Furthermore, the tree model can also be tested against choice data from other individuals in the group. This is necessary in order to predict the behaviour of people in a group.

(a) Ethnographic Interviews and Participation Observation

Ethnography is the work of describing a culture from the native's or insider's point of view and not from the researcher's or outsider's point of view; it is accomplished through field techniques like the ethnographic interview (Spradley, 1979) and participant observation (Spradley, 1980). The goal of ethnography is to grasp the native's point of view, his relation to life, to realize his vision of his world (Malinowski, 1922). Thus, ethnography means learning from people rather than studying people. Ethnographic interviews are described as a series of friendly conversations into which the researcher slowly introduces new elements to assist informants to respond as informants (Spradley, 1980). Spradley explains that the aim is to discover the cultural meaning of the insiders' relationships, native terms, rules, and the way of life. Because ethnographic interviews involve purpose and direction, they will tend to be more formal than friendly conversations. For example, one should start with friendly greetings and explain the project to informants to put them at ease. Then one should follow up with a descriptive question to get the informant talking. It is necessary that one should explain that one does not know anything about the cultural scene and the informant is an expert and that one should express one's cultural ignorance.

Participant observation in a social situation has two purposes: (1) to engage in activities appropriate to the situation and (2) to observe the activities, people, and physical aspects of the situation (Spradley, 1979). Spradley points out that one important contrast is the degree of the researcher's involvement, both with people and in the activities they observe. There are five types of participation depending on the degree of involvement: (1) nonparticipation, (2) passive participation, (3) moderate participation, (4) active participation and (5) complete participation.

In nonparticipation the researcher has no involvement with the people or activities studied. He or she collects data by observation alone. In passive participation the researcher is present at the scene of action but does not participate or interact with other people to any great extent. The degree of involvement with people and the activities they observe is low. Moderate participation occurs when the researcher seeks to maintain a balance between being an insider and an outsider, between participation and observation. The active participant seeks to do what other people are doing, not merely to gain acceptance, but to more fully learn the cultural rules of behaviour. Complete participation involves a high degree of participation when the researchers study a situation in which they are already ordinary participants. Ethnographic interviews and participant observation will also include ethnographic record which consists of field notes, tape recordings, pictures, artifacts, and anything else that documents the social situation under study.

(b) Sampling Procedure

Development of a decision model involves eliciting of decision criteria from a sample of decision makers (Gladwin 1989a). Gladwin explains that to build a decision model one should interview two subsets of people; for example, those who adopt and those who do not adopt the innovation, in order to capture as much variation as possible in the sample. The reason is that one should

select a sample that is as representative as possible of the population of people who make the decision. Regarding the sample size, Gladwin argues that her experiences from her previous studies showed that 20-30 informants in a relatively homogenous culture is sufficient. She explains than the central-limit theorem assures that all distributions tend to normal when n approaches 25. Gladwin states that although the sample is admittedly small, because the model can be tested it can help to predict the actual choice behaviour of individuals in a group. She argues that if the decision model successfully predicts 85-95 per cent of the individual choices of the individuals in the group, it is assumed to be an adequate model of the individual decision process for that group of individuals.

(c) Building a Composite Decision Model

Building a decision model is done by eliciting decision criteria through ethnographic interview and participant observation. Gladwin (1989c) specifies that there are two methods of building a composite decision trees: the indirect and the direct method. Both methods require the interviewer to look for contrasts in the decision behaviour of the informants and ask them to explain any contrasts. Examples of contrasts include those who adopt and who do not adopt the new sheep breeds.

The indirect method involves building one composite decision model for the group as one proceeds with the interviews. For example, after the decision criteria are elicited from one decision maker, the interviewer goes on to another decision maker and tests them on him or her. If the criteria are correctly specified, they cut the sample of decision makers into two subsets: those who pass or satisfy the criteria and decide to do X and those who fail the criteria and decide not to do X. If the criteria are not correctly specified, they do not cut the sample and more

information is required in order to revise or identify the new criteria. Once the criteria cut these will show that they will predict the decision behaviour.

The direct method consists of building an individual model of each informant's decision process and then putting them together into one composite decision model. For example, after the decision criteria are elicited from the decision maker a decision tree is drawn for him or her. Similarly, separate decision trees are drawn for the other decision makers based on the decision criteria elicited. These different decision trees are then combined together to form a composite tree model.

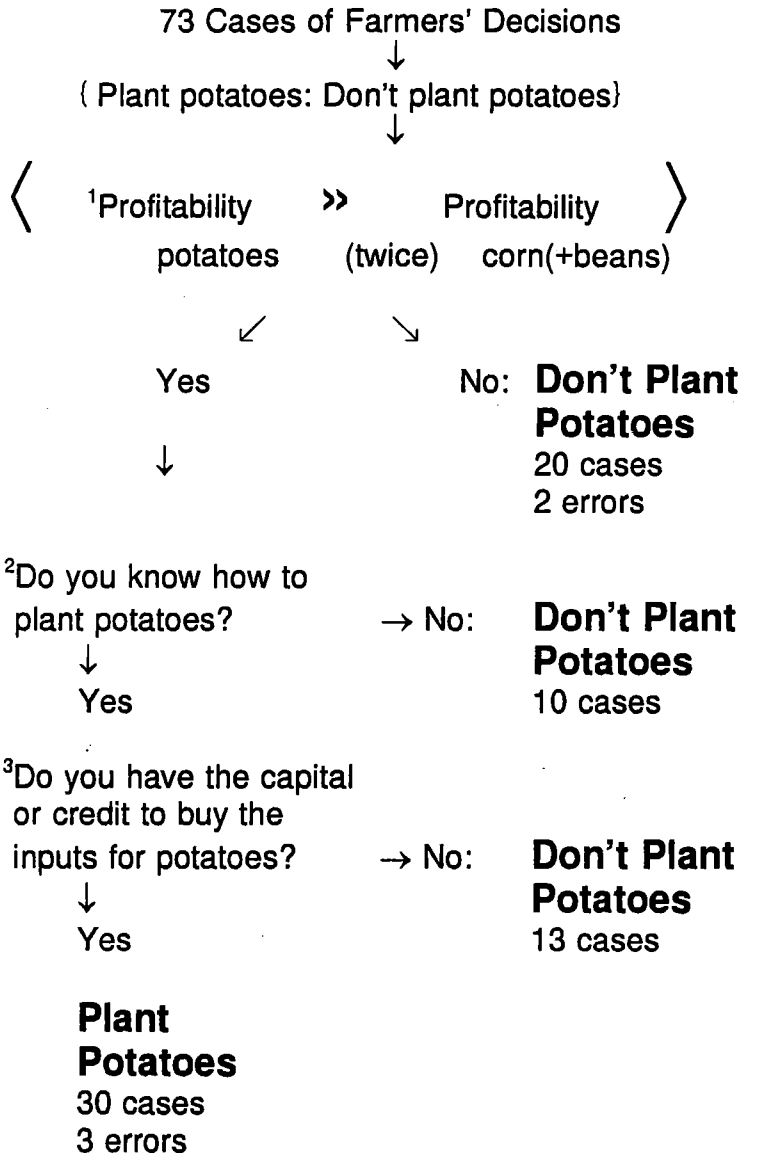
The form of a decision is simple. The choice alternatives are in a set at the top of the tree. The decision criteria are at the nodes of the tree. These decision criteria can either be simple orderings of alternatives on some aspects or dimension of the alternatives. They can also be constraints that must be passed or satisfied. The decision outcomes are at the ends of the paths of the tree.

(d) Model Testing

Once the decision model is built, based on interviews with one set of decision makers, it can be tested for accuracy in predicting choices made by another sample of decision makers from the same group (Gladwin, 1989a). Gladwin states that the test stage is necessary for a predictive study, which attempts to predict actual choice behaviour of individuals in a group. In this test, each decision criterion which has been identified to build a decision model is a question in a questionnaire. The questions used in testing in this questionnaire are no longer open-ended, as were the questions in the model-building stage. They are simply yes/no questions which elicit informants' yes/no responses used to test the model. The test also produces errors if the informant

does not hear or understand the question properly or misinterprets the question. The resulting error rate tells how well the model predicts. Gladwin argues that if the decision model successfully predicts 85-90 per cent of the choices of the individuals in the group, it is assumed to be an adequate model of the individual decision process for that group of individuals. In testing the model, errors are counted on each path, and a success rate for the model is calculated by dividing the total number of successes by the total number of cases on all paths.

The criteria or constraints are discrete rather than continuous variables. The decision process is also deterministic rather than probabilistic: that is, the alternative either passes the criteria or constraints or it does not. There are thus no probabilities. A decision tree is thus a sequence of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice. An example of a decision tree is given in Figure 6, the hypothetical example of a Third-World farmer's decision of whether to plant potatoes (the cash crop) or corn (the subsistence crop). In this tree, criterion 1 orders the two alternatives, potatoes and corn (always associated with beans), on the aspect of profitability: "Is the profitability of potatoes more than twice the profitability of corn and beans?" If the profitability of potatoes are not more than twice the profitability of corn/beans farmers will not plant potatoes. The decision criteria can also be constraints that must be passed or satisfied on the path to a particular outcome, e.g., "Do you know how to plant potatoes?" or "Do you have the capital or credit to buy the inputs for potatoes?" In this example, potatoes must pass profitability, knowledge, capital/credit constraints for the farmers to choose the outcome "Plant potatoes." The path to this outcome "Plant potatoes" can also be expressed as an if-then decision rule (Gladwin, 1989a). According to Gladwin, if farmers consider that potatoes are profitable, and they know how to plant them, and have the capital/credit for the purchase of the inputs, then they will plant them. However, if the alternative "potatoes" fails any one of these criteria, the model predicts that the farmer will not plant



Note: Footnote to denote the decision criterion

Figure 6: A Hypothetical Example of a Cropping Decision Model
(Source: Gladwin 1989c)

potatoes. The model makes an error if it predicts that the farmer plants potatoes but he or she does not or if it predicts that the farmer does not plant potatoes but he or she does. In this case, there were five errors, giving a model predictability of 93 per cent.

(e) Applications

This model of real-life choices or natural decision process have been used in a number of different cultures. Some of the examples are as follows: (1) fertilizer adoption decisions (Gladwin, 1976, 1977, 1979a, 1979b, 1989c), (2) California families' decisions regarding the sexual division of labour within the family for daily routine task (Mukhopadhyay, 1984), (3) farmers' cropping decisions (Barlett, 1977; Gladwin, 1980, 1983), (4) peasants' choice of treatment for illness (Young, 1980), (5) buyers' choice of car (Gladwin and Murtaugh, 1980), (6) economic development decisions (Schoepfle, Burton and Morgan, 1984), and (7) fish marketing decision (Gladwin, 1971; Gladwin, 1975; Quinn, 1978).

In each case where the method has been used, the predictability has been as high as 85-95 per cent of the actual choice data used to test the model. These success rates are remarkable, somehow since it has a very good predictability rate in its own right as well as that economic models do not test against choice data collected from individuals (Anderson, 1974; Benito, 1976; Moscardi and deJanvry, 1977: quoted in Gladwin, 1983).

Gladwin (1976) used this hierarchical decision model to carry out a study of farmers' adoption or non-adoption of the agronomic recommendations of the Puebla Project, Mexico. The project focused on obtaining recommendations about fertilizer use and plant density for the local variety of maize. The aim of the study was to view the Plan Puebla through the eyes of the proposed

adopters of the new practices. The study was on the decision making process of a small sample of farmers in one village concerning the recommendations of the plan in order to identify the factors limiting adoption of the recommendations.

Gladwin developed decision models for each of the farmers' four decisions: (1) to get credit for fertilizer, (2) to increase plant density, (3) to increase frequency of fertilizer applications, and (4) to use a recommended fertilizer rate per hectare. The decision models were developed after intensive interviews with 20 farmers in the village to discover their reasoning and elicit their perceived alternative and decision criteria. They were then tested in interviews with different group of farmers.

Using this method, Gladwin was able to pinpoint a critical node or main factors limiting adoption of each recommendation in the village. Gladwin's findings were summarized as follows:

(1) The farmers had decided not to use the recommended fertilizer rate because they were lacking capital or credit. The model predicted 82 per cent of the farmer's decisions about the fertilizer recommendation

(2) The farmers had decided not to increase the plant density because they were lacking knowledge of the actual recommendation. The model successfully predicted 85 per cent of the farmers' decision about the plant density

(3) The farmers had decided not to increase the number and change the timing of fertilizer application because they thought that it was not a profitable recommendation. The model predicted 97 per cent of the farmers' decision about fertilizer application at planting.

Gladwin (1979a) concluded that farmers' reasoning behind the traditional way and the factors limiting the adoption of the new practices must be understood. She argues:

> "Farmers will not adopt a recommendation unless they have a good reason to do so (e.g., unless the recommendation is more profitable and passes risk and capital or credit constraints). In order for farmers to adopt, a recommendation must be demonstrably better than the status quo alternative on at least one decision criteria and must pass all of the other constraints previously passed by the traditional way." (p.170)

There is another study which demonstrates the practical usefulness of this model. Gladwin (1983) used the model to formulate the cropping-decision model which was used to explain to Guatemala government policy planners why Indian farmers in the Highlands always plant maize. The government wanted the farmers to grow cash crops with higher monetary returns. Maize was considered as a subsistence crop and could be purchased in the market. Gladwin developed the model by interviewing 60 farmers and tested with decision data from another 118 farmers in the Highlands. (The decision model had a 90 percent success rate.) Gladwin discovered that farmers gave priority to maize because it was their main consumption crop. Farmers would consider planting cash crops if they were more profitable or at least two times as profitable as maize. The research findings had wide implications for the future direction of research and extension for the farmers in the highlands of Guatemala.

4.4 Summary and Conclusions

The literature reviewed here shows the different views and approaches concerning farmers' decision making. Dillon (1971) in an extensive review article argues that the Bernoulli's Principle provides a mechanism for ranking risky prospects in order of preference, the most preferred prospect being the one with the highest utility. The theory implies that farmers' responses to uncertainty are guided by utility maximisation rather than profit maximisation.

Brase and La Due (1989) described farmers' investment behaviour based on an economic or socio-economic point of view. Bryant and Johnston (1992) then introduced the three types of decision making models namely: the comprehensive rationalist approach, the disjointed-incrementalist approach and the mixed-scanning approach. The importance of each model depends on how and where it is going to be used. However, researchers have disputed the practicality of these expected utility models in the real-life decision making. For example, Lewis and Thiele (1981), in a review of literature on decision making expressed reservations on the validity of these models in the actual practice at the farm level. Gladwin (1989a) rejected the expected utility theory and introduces a cognitive approach to decision making. She argues that people, due to information-processing deficiencies, use procedures that simplify their decision-making calculations. People make decisions by comparing alternatives, not by ranking the options. They use decision criteria with discrete yes or no outcomes. These procedures are represented by a decision tree model. Once the model has been developed it can then be tested against a different group of people and evaluated for its success rate in order to show how well the model can predict.

The aspects of the economic or comprehensive expected utility models and the diffusion model to describe farmers' decision making have been highlighted. Similarly, the aspects of the cognitive approach called the ethnographic decision tree modelling have also been described. The latter provides an alternative approach to understand farmers' decision making from their point of view. This approach is used in this research to identify the main reasons for farmers to adopt or reject the new sheep breeds. In the next chapter, the method of conducting the study using the decision tree model will be described.

CHAPTER 5

METHOD

5.1 Introduction

Chapter 4 described some of the common decision making models and the ethnographic decision tree modelling which is used in this research. The ethnographic decision tree modelling starts from the assumption that the decision makers themselves are the experts on how they make the decisions. It uses ethnographic techniques to elicit the specific decision criteria used by the decision makers when making a real-world decision, and uses the decision criteria to build a decision model. In order to learn how farmers made their decisions, it was decided to conduct an ethnographic interview with two groups of sheep farmers - the adopters and non-adopters of the new sheep breeds - in the Canterbury area.

This chapter describes the area of study, the ethnographic interview and decision model development. A description of model testing will also be presented.

5.2 The Area of Study

The Canterbury region was chosen as the area of study. In this section the area will be briefly described and the reasons for its selection will be outlined.

(1) Canterbury : General Features and Farming Systems[7]

The Canterbury region covers 3.92 million ha (14.5 per cent) of New Zealand's total 26.9 million ha. It has a population of 450,000 people. The area can be divided into five distinct regions: high country, foothills, downs, Canterbury plains and Banks Peninsula. The rainfall varies from 900 mm near the hills to 500 mm at the coast, and the mean annual temperature ranges from 10°C to 13°C in different parts of the region.

Canterbury accounts for about 16 per cent of New Zealand's livestock and over 57 per cent of its arable crops. The region has a diverse land forms and climate and, therefore, has a wide variety of production systems. Sheep and beef farming are on the high country and the foothills. On the plains are farms with both sheep and crops. There are about 2,332 sheep farms in Canterbury. Total sheep numbers in 1991 were 10.1 million out of which 6.6 million were breeding ewes. Canterbury is the centre of New Zealand's stud breeding industry, with all breeds represented.

Merinos are run on the very high country, but in general halfbreds, fine-wool Corriedales, and to a lesser extent Perendales dominate the high country. Corriedales are popular on the dry rolling country and dry land flats.

Strong-wool breeds such as Romneys, Coopworths, Borderdales are popular on the wet clay downs and the remaining lowlands, especially where there is summer moisture from irrigation or rainfall.

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7 Extracted from Farm Management Notes 1993: Farm Management Department, Lincoln University.

Lambing percentages range from 80-140 per cent, with an on-farm range of 74-105 per cent survival to sale in the 1991 season. The average per head greasy wool yield is 4.5-5.0 kg (3.5-3.8 kg clean). Cross-breeding for prime lamb production is increasing. Canterbury produces excellent export lambs. It is suited to out of season and heavyweight lamb production. The general trend is for hill country properties to produce store lambs for sale to down country farmers for finishing for export. It also supplies replacements for breeding stock. In addition to the traditional breeds, farmers have also introduced exotic breeds such as Texels, Oxford Downs and Finnish Landrace.

The other types of livestock are cattle (beef and dairy cattle), poultry, pigs, deer and goats. The main cash crops are wheat, barley and peas. Flat terrain, moderate rainfall, and low summer humidity make Canterbury an important grain-growing region.

(2) Reasons for Selection

There were two main reasons why Canterbury area was selected. First, the farmers were close to Lincoln University. This would reduce the costs and time spent in travelling to complete the survey. Second, MAF had carried out a survey on the use of exotic sheep by farmers in the Canterbury region. They revealed that about 26 per cent of the farmers have introduced exotics on their farms.

5.3 Ethnographic Interview and Decision Model Development

A small and non-random sample of 40 sheep farmers in Canterbury was selected for the ethnographic interviews conducted in January and February, 1993. These farmers represented two subsets of farmers: 26 adopters and 14 non-adopters of the new sheep breeds. The adopters'

group consisted of 17 Texel, six Oxford Down and three Finnish Landrace breeds' adopters out of which six were commercial farmers[8] and 20 were stud breeders[9].

For the non-adopters' group, six were commercial farmers and eight were stud breeders. The reasons for getting both the adopters and non-adopters were in order to capture as much variation as possible in the sample. For the purpose of this study, an "adopter" is defined as someone who is trying out an innovation on the farm.

The names of farmers were obtained from the New Zealand Sheep Breeders Association, the Farm Management Department, the Canterbury Texel Club and from the farmers themselves. The farmers were selected from various areas in Canterbury so as to capture as much variation in the sample. Figure 7 shows the distribution of the selected farmers in Canterbury.

A letter explaining the purpose of the research was sent to all selected farmers. A copy of this letter is included in Appendix 1. The interviews took place either in the house or in the sheep sheds. All informants were again explained the purpose of the research.

Some questions to collect information on the personal particulars of farmers and background information of their farms were asked. The farmers were asked to describe their farms and its physical features, farm type and size, and length of stay on the farms. They were asked to describe the performance of their existing breeds of sheep such as the lambing percentage, wool

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8 They are concentrating on producing prime lambs for sale to the markets.

9 Sixteen were involved both in stud and commercial programmes. Only five farmers interviewed were purely stud breeders.

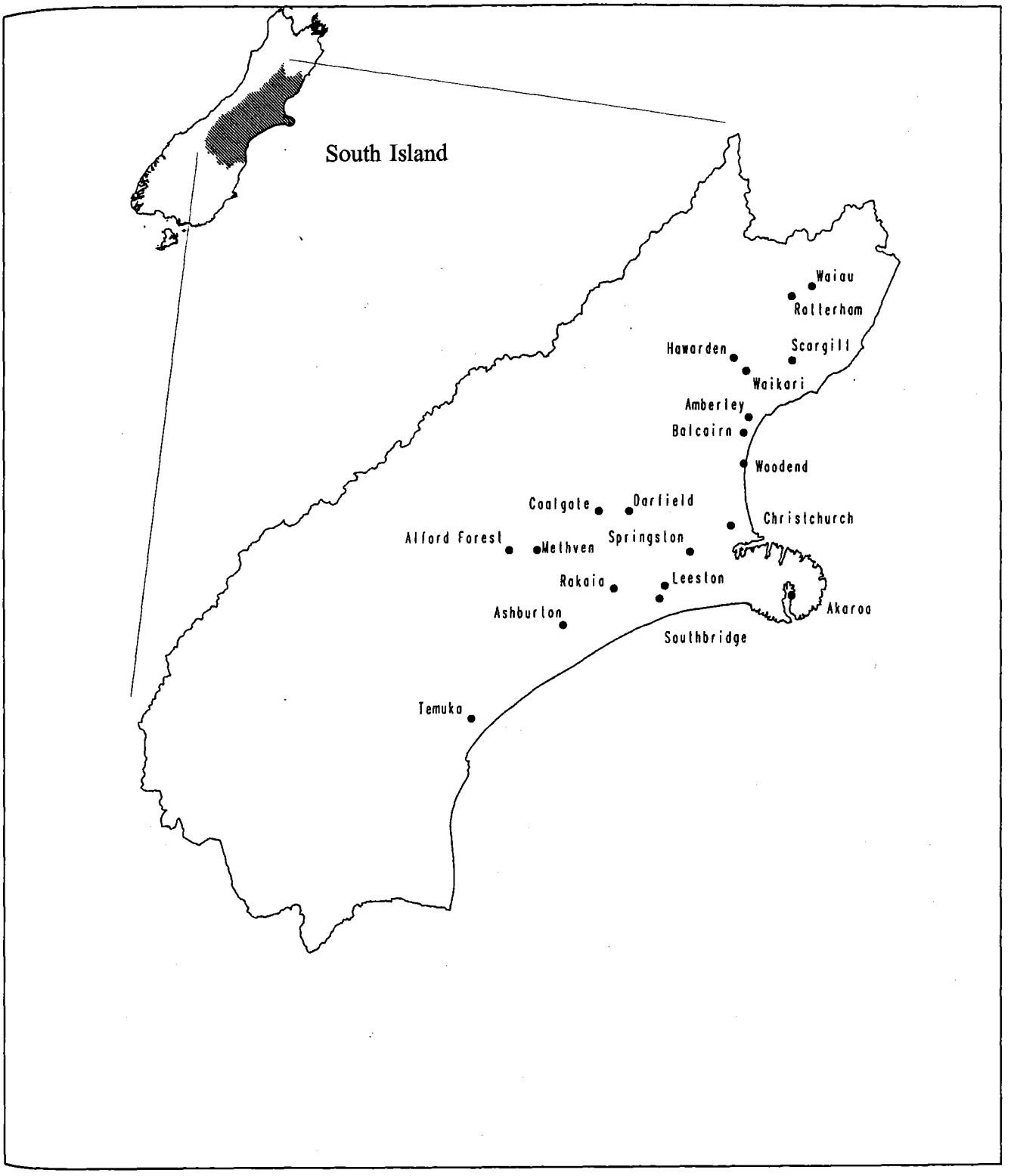


Figure 7: Map of the Canterbury Region with Locations of Farmers Interviewed

and meat production, animal growth rates and other attributes of their sheep. These questions were typed out, but with the exception of these preliminary questions, the interviews were unstructured.

Selection or specification of decision criteria or constraints to build a decision model was the hardest part in modelling. The adopters and the non-adopters were used to provide the contrasts in order to discover their decision criteria. The adopters of the new sheep breeds were asked three key questions: (1) when did they first introduce the new sheep breeds, (2) how did they obtain the information about the new breeds, and (3) what were their main reasons or motivation for deciding to introduce the new breeds. The non-adopters were asked two key questions: (1) were they aware of the information about the new sheep breeds, (2) what were the main reasons or constraints preventing them from introducing the new breeds of sheep.

These descriptive questions were asked in order to get the informants talking. This was necessary because the informants were the expert in the cultural scene. This general format of a few key questions was followed for all informants. An active type of participant observation was used where the author not only observed but also sought to do what the informants were doing. The reason was not only to gain acceptance but also to learn the cultural rules of behaviour, such as helping the farmers to install pipes in their farms for irrigation purposes and also helping them in the sheep yard to identify the good sheep breeds for breeding purposes. All interviews were tape recorded. Brief field notes of each interview were also made at the time of the interview. Some publications regarding farmers' sources of information about the new breeds of sheep were also obtained during the interview. Photographs were also taken.

Each interview was fully transcribed. The detailed transcripts and field notes were examined and analyzed thoroughly, and then put in summarized form. All the information the informant had given was examined in order to identify the decision criteria, key phrases or other constraints, and these data were used to develop the decision tree.

In this research, the direct method was used to build a composite decision model. All the different decision trees from all informants were combined in logical fashion to form a decision model. The decision criteria were also combined in order to produce a decision tree that made sense and predicts well enough. At the same time, while building a decision tree particular decision criteria were generalized into one criterion that reflected the individual views. For example, the attributes of leanness, reproductive rate, early maturity and so on were combined as one criterion - genetic improvement. The ethnographic validity of each individual decision model was thus maintained when building the tree. Non-adopters provided the main reasons or constraints preventing farmers from adopting the new sheep breeds.

The interviews were comprehensive and covered many aspects and attitudes of decision making regarding the adoption of the new sheep breeds. The detailed transcripts and the summary notes provided sufficient data to elaborate the decision criteria. In formulating the decision tree attention was given to what farmers actually said and thought about the new breeds of sheep. The opinions, viewpoints or judgements about the breeds were reflected by the farmers themselves on what they perceived or believed.

In addition to interviews with the adopters and non-adopters of the new sheep breeds, the author also gathered information from an agricultural consultant attached to MAF. He was responsible for the marketing and sale of the breeds and was able to provide information on farmers'

marketing strategies and also their reactions to the new breeds.

5.4 Decision Model Testing

Ethnographic decision tree modelling can be tested to see how good a representation of reality it really is. In this study the model was tested against actual choice data collected from a non-random sample of decision makers. The procedure was carried out by interviewing a new independent sample of 20 farmers consisting of 12 adopters and eight non-adopters of the new sheep breeds. That is, those farmers who had been interviewed earlier for building a decision tree model would not be selected for the purpose of testing the decision model. The names were obtained from those farmers who had been interviewed earlier for building the model. They were selected from different parts of Canterbury so as to capture as much variation as possible. They were interviewed by telephone.

In the test, each node or decision criterion in a model was a question in a questionnaire (see Appendix 2). Any errors were identified and the percentage predictability was then calculated (an error is made if the actual choice and the prediction from the tree do not agree). The percentage predictability is the ratio of correct predictions of farmers' choices divided by the total number of farmers who made the choice.

5.5 Chapter Summary

In this chapter, a method used to study farmers' decision-making process was described. Ethnographic interviews and participant observation were used to collect data or to elicit decision criteria used by decision-makers. Procedures of how to build a decision model from the decision

criteria and how to test the model have also been described. A brief descriptions of the physical features and the types of farming systems of the area of study and the reasons of its selection were also reported.

CHAPTER 6

RESULTS

6.1 Introduction

In this chapter, the results of farmers' decisions to adopt or reject the new sheep breeds will be presented in the form of a decision tree. The chapter begins by introducing the types of information sources farmers used for their information and knowledge about the exotic sheep breeds. These sources were used to show or explain to the farmers what they should expect from the new breeds. The farmers themselves would decide whether the information available to them were reliable or important in their decisions to consider the breeds. Next, the chapter highlights the main decision criteria used by farmers for adopting the breeds. It also reveals the main reasons for farmers to reject the new sheep breeds. The results of the model testing will also be presented. The chapter ends with a summary of the reasons given by farmers to adopt or reject the new sheep breeds.

6.2 Sources of Information about Exotic Sheep Breeds

All farmers who participated in the research were found to be aware of the new sheep breeds. They obtained information and knowledge about the breeds from various sources. The sources frequently mentioned by the farmers were: field days, information brochures, *The New Zealand Farmer*, personal contact with Sheepac and LambXL, meeting/seminar, friends, quarantine farms, *The Press*, overseas trip and discussion groups (Table 1).

Source	No. of farmers mentioned	% of farmers mentioned
Field days	36	90
Information brochures	30	75
New Zealand Farmer	29	72.5
Personal contact with Sheepac (MAF)	19	47.5
Personal contact with LambXL	18	45
Meeting/Seminar	13	32.5
Friends	12	30
Quarantine farms	6	15
The Press	4	10
Overseas trip	4	10
Discussion group	3	4.5
Total Number of Farmers Interviewed:	40	

Table 1: Main Sources of Information

Ninety per cent of the farmers interviewed indicated that they obtained information about the new breeds from field days. The field days were organized by Sheepac or LambXL - the two companies responsible for the publicity and sale of the breeds. The regional Agricultural and Pastoral (A & P) Associations also organised their annual field days where the new breeds of sheep were promoted. In the South Island, the main A & P show is the Christchurch Show which is organised yearly. During the field days the new sheep breeds including their progenies were displayed for the public to see. Some Texel meat carcasses were also exhibited. The representatives from LambXL and Sheepac were present to explain to the people the attributes of the breeds and benefits they could obtain by using the new breeds. The organizers also invited some representatives from other commercial organizations such as the Freezing Company, the Meat Board, the Wool Board and so on. All the farmers (adopters and non-adopters) agreed that field days provided a very good venue for information and knowledge about the new sheep breeds. They indicated that the field days provided them the opportunity to view and assess whether or not to purchase the new animals. They also said that they could share ideas and opinions with other farmers and friends concerning the breeds.

Information brochures, leaflets and handouts were distributed to the participants. Seventy-five per cent of the farmers mentioned that they obtained information about the new breeds from the brochures. These brochures included photographs of the new breeds and trial data obtained from quarantine stations in this country and also from overseas. Similarly, photographs of these new sheep breeds and trial data were also displayed at the show. Some information on the type and results of crosses made and all the good attributes about the new breeds were also shown. For example, farmers were told that the unique features about the new sheep breeds were (1) Texels were good terminal sires for producing lean meat with very low fat, (2) Finnish Landrace have high lambing percentages and were recommended for use in the hill country areas where lambing

percentage was comparatively low, and (3) Oxford Down have faster growth rate and recommended in the dry land areas.

The participants were also put on a mailing list where some of the information brochures were distributed free for those who were interested in considering the new breeds. Some purchase orders were also circulated so that interested farmers could make the order immediately. Some farmers indicated that they had attended two to three field days to obtain information about the new breeds. Some even went to the Agricultural and Pastoral Showgrounds at Fielding in the North Island where the first promotional show and sale of the new sheep breeds was organized.

In addition to field days and brochures, farmers also obtained information about the new breeds from *The New Zealand Farmer*, a weekly farming-magazine which is prominent and well-established in New Zealand. About 70 per cent of the farmers indicated that they received information about the new breeds from the New Zealand Farmer. They indicated that the magazine provided a great deal of information and advertisements about the new breeds of sheep. These included some figures obtained from quarantine trials and from overseas. Some scientists had also expressed their positive views on the genetic potential of the new breeds for the improvement of the sheep industry in the country. Farmers regarded *The New Zealand Farmer* as one of the most important sources of information concerning the new breeds.

The other most important source of information was direct contact with the officers from Sheepac and LambXL. These two companies were mentioned by the farmers studied because they were directly responsible for the importation and sale of the new breeds. Some farmers had direct personal contact with the representatives or officers from Sheepac and LambXL and obtained information about the new breeds. They were then issued with some brochures or leaflets.

A few farmers also mentioned that they had attended meetings or seminar which were either organized by Sheepac or LambXL and that these were their sources of information about the breeds. Some farmers also sought the opinions and views from friends especially those who had travelled overseas and had seen the new breeds either at shows or in farmers' fields. They discussed among themselves the advantages and disadvantages of the new breeds. Few had attended quarantine farms where trials on the performances of the new breeds were conducted. From the interviews four farmers mentioned that they obtained the most valuable information regarding the new breeds from their experience in overseas countries such as France and United Kingdom. They had been to European countries and had seen for themselves the new breeds on farmers' farms and also the meat carcasses exhibited at the agricultural shows. They had also seen the meat available at the big supermarkets in European countries. From their overseas experience they found that there were vast difference between the New Zealand lamb carcasses and that of the European lamb carcasses. For example, they observed that Texels have lovely eye muscle with very thin layer of fat or hardly any fat at all. They said that the animal also has beautiful conformation of carcass, big hindquarters, and big eye muscle. They also mentioned that while attending the Royal Smithfield Show they discovered that Texels won all the meat competitions organized in connection with the show.

It was also discovered from the interviews that another way of getting information about the new breeds was from Farm Discussion Groups. Some farmers indicated that during the meeting they invited farm consultants from commercial firms and also from Sheepac and LambXL to give them a talk on new farm innovations which included the new sheep breeds. According to them the discussion group in the area also provided some information and guidance in the decision to consider the new breeds.

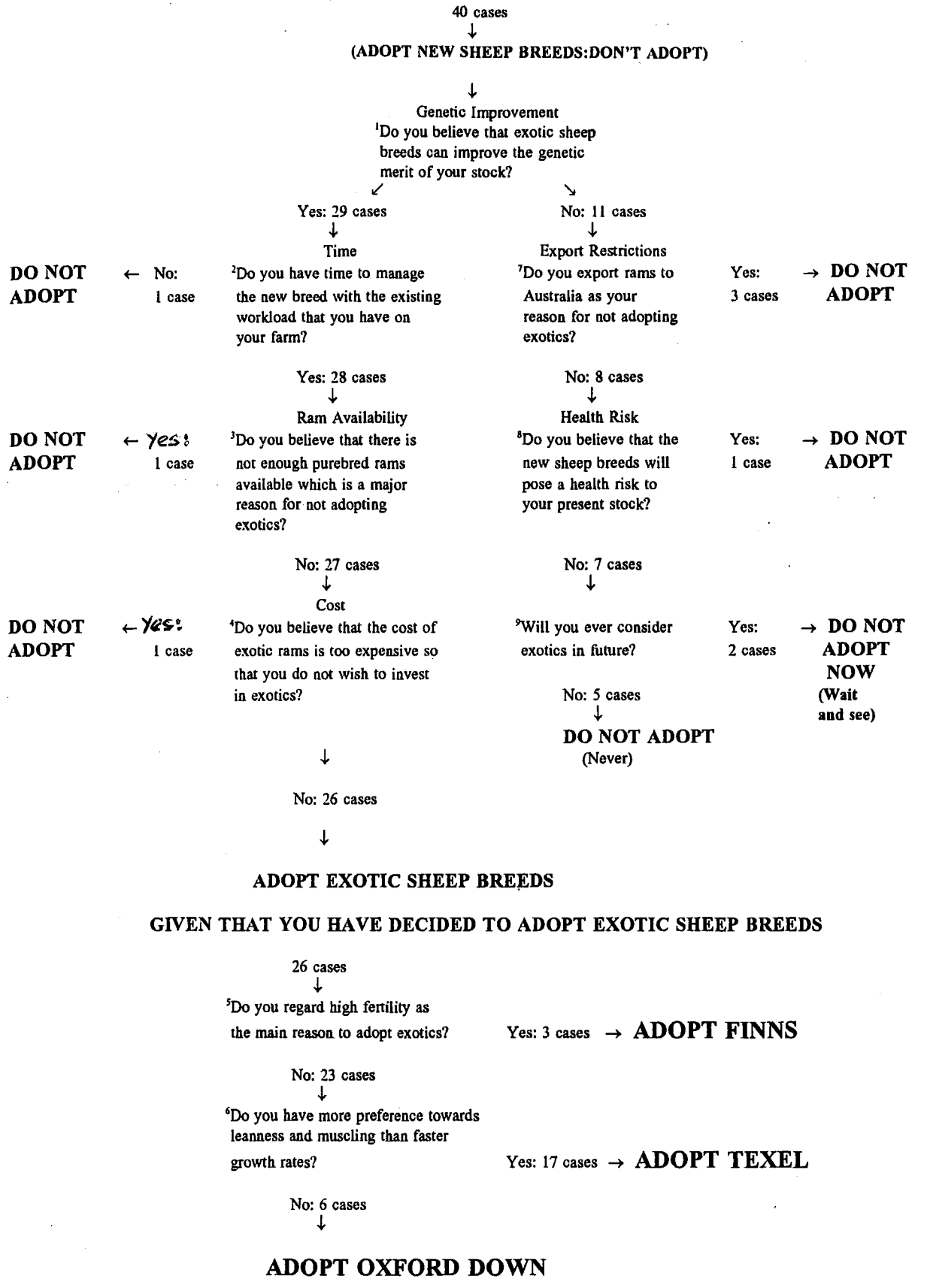
An interview was conducted with an agricultural consultant from Sheepac to ascertain how they promoted the new breeds. The consultant mentioned similar information as the farmers. These included the use of advertising through farming magazines, radio and the press to create awareness among the farmers on the expected attributes of the new breeds and the benefits the farmers could get from them. Field days and direct personal contact with the stud breeders were used to promote the actual sale of the sheep. During the field days information brochures, photographs, pamphlets and handouts which contained some trial figures which were done at the quarantine stations and also some figures from overseas were distributed. The sheep consultant mentioned that most of his sheep were sold through field days.

In summary, this section has identified the main sources of information that farmers used for information regarding the new sheep breeds. The principal sources of information mentioned by the farmers were the field days, information brochures, *The New Zealand Farmer*, contact with officers from Sheepac and LambXL, meetings/seminars, friends, *The Press*, overseas trips and discussion groups. The farmers indicated that they were all very much aware about the new animals. Clearly, the most important role of these information sources was to create awareness among the farmers regarding the new sheep breeds. The information sources were used to show or explain to the farmers what they should expect from the breeds. The farmers themselves would decide whether the information available to them were reliable or important in their decisions to consider the new breeds. There is a need to identify the main decision criteria used by farmers for adopting or rejecting the new sheep breeds and these will be discussed in the next sections.

6.3 Belief in Genetic Improvement

The main criteria used by farmers in their decisions whether to adopt or reject the new sheep breeds had been elicited through ethnographic interviews and participant observation. These criteria were then presented in the form of a decision tree as shown in Figure 8. The tree identifies the main reasons for farmers to adopt and the limiting factors or constraints to reject the new sheep breeds.

As shown in the decision tree, criterion 1 orders the two alternatives whether to adopt or reject the breeds on the aspect of genetic improvement: "Do you believe that exotic sheep breeds can improve the genetic merit of your stock?" It was found that genetic improvement was the key decision issue in the decisions whether to adopt or reject the new sheep breeds. There were 29 farmers believed and 11 farmers did not believe in genetic improvement. However, those 29 farmers who believed that the new sheep breeds could improve the genetic merits of the stock and expect to produce financial returns did not necessarily make their decisions to adopt the new breeds. There were three farmers who believed on genetic improvement but did not adopt the breeds because of the constraints of time (criterion 2), "Do you have time to manage the new breed with the existing workload that you have on your farm?", ram availability (criterion 3), "Do you believe that there is not enough purebred rams available which is a major reason for not adopting exotics?" and its cost (criterion 4), "Do you believe that the cost of exotic rams is too expensive so that you do not wish to invest in exotics?". There were 26 farmers who did not encounter these constraints and thereby preferred to adopt the new breeds. Those who preferred the attribute of high fertility (criterion 5), "Do you regard high fertility as the main reason to adopt exotics?" would adopt Finns. Those who had more preference towards leanness than faster growth rates (criterion 6), "Do you have more preference towards leanness and muscling than



Note: Footnote to denote the decision criterion

Figure 8: Farmers' Decisions to Adopt the New Sheep Breeds

faster growth rates?" would adopt Texels and Oxford Downs, respectively. The findings also showed that there were 11 farmers who did not believe that the new breeds could improve the genetic merits of their stock and would not adopt the breeds. The other factors associated with disbelief in genetic improvement and non-adoption were export restrictions (criterion 7), "Do you export rams to Australia as your reason for not adopting exotics?", and health risk (criterion 8), "Do you believe that the new sheep breeds will pose a health risk to your present stock?" The main reasons for decisions to adopt or reject the new breeds will be explained in Section 6.4 and Section 6.5 respectively.

6.4 Decisions to Adopt Exotic Sheep Breeds

This section describes the main decision criteria used by farmers for adopting the new sheep breeds. It describes the influence of genetic improvement on farmers' decisions to adopt the breeds. It also describes the main criteria used for adopting a particular type of the new sheep breeds. The descriptions of the attributes of the new breeds of sheep from farmers' viewpoints will also be included. The end of this section describes the summary of reasons to adopt the new breeds of sheep.

Farmers who believed that the new breeds could improve the genetic merits of their present stock (criterion 1), "Do you believe that exotic sheep breeds can improve the genetic merit of your stock?" and did not have the constraints of time (criterion 2), "Do you have time to manage the new breed with the existing workload that you have on your farm?" and ram availability (criterion 3), "Do you believe that there is not enough purebred rams available which is a major reason for not adopting exotics?" and its cost (criterion 4), "Do you believe that the cost of exotic rams is too expensive so that you do not wish to invest in exotics?" would adopt the new breeds.

There were 26 farmers who decided to adopt the new breeds: three adopted Finns, 17 adopted Texel, and six adopted Oxford Downs. The following sections will describe in detail the reasons for adopting these new breeds and the attributes of each breed.

6.4.1 High Fertility

Some farmers considered that there was a need to increase lambing percentage of the traditional breeds in certain areas especially in the hill country. They argued that if they could increase the present lambing percentage they would be able to improve their income with the increase in the number of animals from their farms. There were three farmers who decided to introduce Finns into their farms. They all agreed that their main reason for adopting Finns was because of their high fertility (criterion 5), "Do you regard high fertility as the main reason to adopt exotics?"

Marie[10] is 55 years and owns about 20 hectares of land. She is retired and has taken up stud breeding as her hobby. She has got four purebreds ewes and one ram. According to her the information she received about Finns was that it has high fertility. She wanted to experiment on the new breed - to see how they would perform on her farm. She said that she will consider buying some traditional sheep breeds to expand her breeding programme. She has the opinion that the new breed might be of use by farmers in her areas in the near future. Marie has this to say about the new breed:

> I was really interested in Finns because they have multiple breeding, lean meat and also have a very fine wool. They are good mothers too. These attributes are appealing to us when compared to Oxford Downs and Texels. So we thought we would just experiment with Finns because we thought at that time it was the most profitable thing to do. But I am doing this as a hobby in a little way.

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10 All the names of farmers interviewed were fictitious.

Kelly is 42 years and has about 30 hectares of land. He considered that introducing a small scale stud farm to their horticultural farm would be an economic way of utilising their small farm. According to him Finns are known to be prolific and have high lambing percentages. He thought that this characteristic when introduced into the local breeds in his area would be able to improve the lambing percentage of the conventional breeds. He said that if the lambing percentage of the existing breeds could be improved farmers would be able to derive more returns from their farms. He has two purebreds ewes and one purebred ram. Kelly put it this way his reason of introducing Finns in his farm:

> Finns are very prolific. I am crossing them over to our Romney and Corriedale because these are the two main breeds in this area. I consider the crossbred Finns will be their future rather than the purebred Finns. As the commercial flock gets older a lot of them will lose their fertility and the lambing percentage will come down. And if they can be upgraded the percentage basically they can make profits as well. And if they can lift the lambing percentage for the same number of sheep lambing, this is going to be a lot better than buying a lot more sheep and having to feed those during winter.

Jack is 31 years old and has a slightly different approach to his farming system compared to Marie and Kelly. He has about 200 hectares of farming land for stud, commercial and cropping programmes. He has about 500 sheep and they are mostly Merino. Merino and Romney are used for his Finns breeding programme in addition to his prime lamb production. According to Jack, there was a need to evaluate the performance of crossbred Finns compared with the conventional breeds with respects to lambing percentage and the pre-lamb shearing policy. Regarding his reasons of introducing Finns in his property he said:

> After taking over our property in June 1990 we keenly followed the development of the exotic breeds. We decided to consider Finns because of three major reasons. First, we have to maintain or increase the number of lambs born and reared or to increase the lambing percentage in our property. Second, there is a need to see the result of the combinations of the various types of breed with Finns. According to LambXL a 25 per cent infusion of Finns blood lines will result in a 25-30 per cent increase in lamb drop, with half of the Finns ewes having a mean lamb drop of

> two lambs per ewe. I believe more farmers will make use of the crossbred Finns rather than the purebreds. I would like to evaluate these things on my farm. Third, evidence shows that wool production for Finns is about 20 per cent lower than the traditional breed. But we can implement a pre-lamb animal shearing policy to reduce shearing costs and improve the length of fleece. So this will offset the reduced income from wool.

Jack also mentioned that there is a great potential for the new sheep industry in the country. He added:

> A lot depend on the attitude of the meat companies, wool market and the average needs of the farmers. Perhaps there have been few people who have been "burned" with deer, goats and Merino. A lot of money have been paid for Merinos and not too many years the wool market has dropped drastically. So people would like to try for themselves and to see how the new things would perform in their farms.

Hence the farmers who had decided to adopt the Finns did so if they needed to improve the fertility or lambing percentage of their flock. If they satisfied the fertility criterion, the decision model predicted that they would adopt Finns. The next sub-section will describe the main attributes which were used by farmers in their decisions to adopt the Texel breeds.

6.4.2 Leanness and Muscling

Some farmers had mentioned that they would consider the new breeds if there was a need for more leanness and muscling in their flock. If they satisfied this leanness and muscling criterion as the main criterion (criterion 6), "Do you have more preference towards leanness and muscling than faster growth rates?" the decision model predicted that they would adopt the Texel breeds. There were 17 farmers who decided to adopt this new breed based on this criterion. The other characteristics of Texels which were considered as beneficial side effects by the farmers were meat yield, heavy hindquarters, big eye muscle, good carcass conformation, faster growth rate,

bulky wool, compatibility with existing breeds and profitability. Each of these attributes will be discussed in turn.

Some farmers said that they have problems of overfatness in their flock and considered Texels might be able to solve this problem. For example, Alexander, a 40-year-old sheep farmer, is a Texel stud breeder and also produces prime lambs from his farm. He described his reason of getting Texel in this way:

> I am looking at the different breed or multiple ewes that we introduce to terminal sire in the longer term. We are having a problem with our Suffolk-cross ewe lambs that we did not get them weaned before Christmas. They were rather fat and then we have to wait to May till the weather gets colder to get rid of them. So this is one of the reasons we changed to Texels. They said that Texels are extremely lean. They have good muscle at the hindquarters. They have good growth rates, too. I would expect these attributes will help me solve the problem of overfatness on my ewe lambs. The main reason is that I want to see how they perform on this farm. Well, just a small trial first before we started to go in a big scale, because they are very new to us and we do not know exactly how they can perform in our farm.

Andrew and Wilson are both commercial farmers with similar problems. Andrew is a 42-year old farmer who has indicated that he has overfat problem in his Corriedale ewe lambs and Wilson has a similar problem with his Coopworth ewe lambs. Andrew remarked:

> We bought a Texel ram because they are supposed to be the most modern sheep around. They are supposed to have good growth rate and produce lean meat with heavy hindquarters, good legs and big eye muscle on either side of the back part. I introduced them as a trial, because I thought it may help me to overcome my overfatness problem in my Corriedale flock ... I guess this is the area that we thought over that makes the greatest gain and these are my priorities. While getting bigger and leaner lambs and therefore getting more money when we sell them.

Some indicated that even though the promoters could not provide enough facts and figures about Texels or to prove that they were superior than the traditional breeds, they preferred to try and

introduce on their farms for further evaluation. As Edward put it:

> Texels are the extension of my stud breeding programme. I decided to put Texels here because they said they have lean meat, low fat content and good muscling. So we thought we should have a small trial on it first. We have to be quite receptive to new things. It might do some good to us in future.

The other attributes of Texels mentioned which were considered as beneficial side effects are higher meat yield or higher dressing percentage and being well muscled. They associated these characteristics in relation to the meat grading system and expected financial benefit from Texel. For example, Bruce, a 55-year-old stud breeder who also produces prime lambs, described the potential of Texel in this way:

> Texel breed, as far as I know, has the lean carcass - the best muscle carcass. They have heavy hindquarters and high muscle area. They have the extra meat from the carcass or have high meat yield. The New Zealand average meat yield is 41-43 per cent, whereas Texels can be up to 50 per cent. They have mentioned about the meat grading system and Fortex is using the Hennessy probe to assess the meat yield of the carcass. This will be a great gain to farmers because they have high meat yield compare to other traditional breeds. So farmers will be paid more for the extra quality they have from Texels.

Bill, a 32-year-old stud breeder and produces commercial lambs, also shared the same opinion with Bruce and said:

> The reason we got them here is because of their muscling and the lean meat. They have less fat and high yielding meat. Now they bring in the new grading system where they are expecting to pay the farmers for the muscling or the yield of the meat. Fortex is going to do it. So this is an advantage to the farmers.

Peter and Francis are full-time Texel stud breeders. Charlie is a stud breeder but also produces commercial lambs from his farm. They had been to European countries and had seen Texels at the agricultural shows and supermarkets. According to them they were very impressed with what

they saw. They wanted to try Texels because they believed that it has the potential to bring genetic improvement to the local flocks in terms of meat quality. For example Peter said:

> I went overseas 3-4 times a year to European countries. There I saw Texel hanging in the market of Europe like the Paris Meat Market...I was very impressed with the quality of European lambs compare with the New Zealand lambs. We are looking at the fresh European lambs against the frozen New Zealand lambs. Texels have a beautiful conformation of carcass, lovely big hindquarters, lovely loin and that is where the quantity of meat is. Also they are good shoulders, not too much fat, big eye muscle. I was most attracted to this animal. And hence my wanting to able to bring them to New Zealand and introduce them to New Zealand farmers.

When Peter retired from the meat industry, he decided to go back to the farm and started his Texel stud in 1990. He also would like to offer his advice and share his experience with farmers in New Zealand. According to him farmers should produce lamb carcasses which have the qualities demanded by the international markets so that they would be able to get more returns. When asked further what prompted him to decide to go back to the farm and introduce Texels, he said:

> I have got into Texels as my hobby. I want to do two things. First, I am trying to tell the New Zealand farmers that for 15-20 years their carcass will be very difficult to compete in the world market...If we really want to have a higher price for our lambs, we have to put it a form suitable for the supermarket trade in the world. And the lambs have to be over 18 kg and with GR less than 10 mm. Second, I am also trying to show to New Zealand farmers that this is the way the farmers have to go. They have to improve the conformations of their lambs, if they are going to get higher prices for the lambs in overseas markets.

The other good attribute of Texels as stated by farmers is that they have a bulky wool. George, Francis, Fred and Gilbert shared similar opinions that Texel wool has more bulk and this will further improve the wool quality. According to them this is an additional gain to the farmers. George said:

> By introducing Texels into my Coopworth flock I am also expected to get

> good monetary returns from the wool in addition to the meat. Texel produces white bulky wool. Our Coopworth give the fibre diameter of 35-36 microns and the Texel cross will be about 32-33 microns. We expect the wool weight to drop somewhat with the Texel-cross but the price will go up because of lower micron and more bulk we can produce from the Texel-cross. This is sought after by the trade industry.

Francis also indicated that Texel-cross wool has more bulk compared to Romney wool. He said:

> They have a springy sort of bulky type of wool compare to those Romney wool. We were informed that Texels have a wool bulk of about 30 cm^3/g and our Romney has about 20 cm^3/g. So there is an advantage and therefore more returns to the farmer.

Bob, an agricultural consultant, has this to say about the wool quality of the Texel-cross. He said:

> The other big advantage from Texels is the wool. One of the real strong points of the Texels is the bulk in the wool. Buyers state quite clearly now that they want more bulk now in the New Zealand crossbred wool clip. Not only that, they also want wool of 30-35 microns. When you cross Texel with the Romney that's exactly what you get. You increase the bulk and reduce the shininess of the traditional Romney which have 38 microns.

The colour of the sheep is also taken into account in the decision to consider the type of breeds in relation to the existing breeds of sheep they already have on the farms. A few farmers stated that they decided on Texels, a white-faced sheep, because they were more compatible with their existing traditional sheep. According to them, the reason was they wanted to avoid any contamination of the fibres from introducing different type of fibres. For example, Bill has this to say regarding his choice of Texels:

> We prefer Texels to Oxford Downs because we have Poll Dorset ewes and Texels have similar breed to Poll Dorset. The Oxford Down is a black-faced sheep and more compatible with the black-faced sheep such as Dorset Down or Suffolk. Poll Dorset wool and Texels' wool are similar and therefore more compatible. Probably if we had black-faced sheep earlier we might have tried the Oxford Down.

All the Texel adopters agreed that they would expect to gain additional financial returns from these new genetic materials from Texels in the long term. For example, they said that they were expecting to get high meat yield from Texel-cross and with the introduction of the meat grading system this would be an advantage to them. They were told by the meat companies that they would be paid a price premium to produce high meat quality in carcass. According to Bill:

> We were informed that we have a new meat grading system now. They have started to grade lamb for meat yield. For example, one of the meat companies such as Fortex is using the Hennessy Probe to assess the meat yield of the carcass. In the past a lot of lambs were sold in carcass form and light weight lamb. We are expected to produce lambs on heavier weight and be paid better prices for that. We believe that Texels can do this for us. This will benefit the farmers in terms of giving them better income and returns from using the new breeds.

George also pointed out that with the good attributes of Texels they would no doubt provide a good investment and a long term monetary return to the farmers because farmers were able to produce what the market demanded. He said:

> Prospects for Texels look good. We would expect to have more financial gains from them. And this benefit will depend on the demands for the breed. The thing is that, if Texels can produce good quality meat, lean meat, bulky wool as the market wants and a good growth rate, then definitely we can make a lot of money out of them.

Bob, in his promotion of the Texel breed, also stated that Texels would expect to provide a good monetary return to the farmers in future because of their ability to produce a heavy weight lean carcass and according to him this was the quality demanded by the markets. He explained:

> Texels are for leanness, big eye muscle, muscling or conformation of the hindquarters. We don't have these attributes in our New Zealand sheep industry. The Texels also allow the farmers to be able to take all those lambs through to heavy weight and leanness, whereas no other breeds in New Zealand will do it without getting any excess of fat. So it has got a huge place to play in the future of our lambs. If the farmers can carry their lambs right to heavy weight they really can capitalise on that dollar, the big dollar market.

Some farmers adopted the new breeds if there was a need to introduce the attributes of leanness and muscling in their flock. If they satisfied this criterion, the model predicted that they would adopt Texels. In addition to this main criterion of leanness and muscling, other beneficial side effects of Texels considered were meat yield, heavy hindquarters, big eye muscle, good carcass conformation, faster growth rate, bulky wool, and compatibility with existing breeds. Farmers associated these attributes of Texels in terms of expected financial returns. There were 17 farmers who decided to adopt Texels. The next sub-section will describe the main attributes which were used by farmers in their decisions to adopt the Oxford Down breeds.

6.4.3 Faster Growth Rates

Some farmers would adopt the Oxford Down breeds if there was a need to introduce the attribute of faster growth rates in their flock (criterion 6), "Do you have more preference towards leanness and muscling than faster growth rates?" There were six farmers who decided to adopt this breed because of faster growth rates. Other attributes of the breed which were considered of secondary importance by the farmers were lean meat, wool fleece weight, easy drafting, good demand, and true to type. These attributes will be described in the following discussion.

All the Oxford Down adopters have agreed that the main attribute of Oxford Down is their rapid growth rate. Some indicated that Oxford Downs have a growth of 500 g per day which they considered as an advantage to those farmers who farm in dry areas or in unirrigated areas. With rapid growth rates they considered the lambs could mature earlier. In this way they argued that they could finish their lambs earlier or before Christmas. For example, Jim a 65-year-old stud breeder, has this to say regarding his reason for considering Oxford Downs:

> In this area there are still a lot of areas that are unirrigated and dry very quickly during summer. People have to get lambs from their work before

> Christmas. These lambs mature early and we can get rid of them at a good weight at a young age.

Harry, Henry, Larry, Philip and Gerald also shared the same opinion with Jim that Oxford Downs have rapid growth rate which is an advantage to their areas. According to Harry, a commercial farmer-cum-stud breeder, his areas are drying up very quickly. They do not expect to get any rain from mid-December through February. They have to farm and lamb in August and get most of their lambs or at least 25 per cent of their lambs away before Christmas. He considered Oxford Downs as the best alternative over the other new breeds because he said they could suit the dry land areas. He mentioned that they have rapid growth rate and expected to reach good weight quickly and so could finish the lambs earlier and at heavy weight.

Farmers also mentioned that other secondary attributes of Oxford Downs are that they produce lean meat and do not get over fat. They said that they were expected to get more financial returns from lean meat. As Henry remarked:

> The other good attribute about Oxford Downs is that they also produce lean meat. The Oxford Down-crossed lambs will average nine per cent heavier and seven per cent leaner at weaning than Suffolk crosses. The lean meat therefore will provide good financial returns to the farmers.

Jim also expressed the same idea. He said:

> The other good attribute about Oxford Downs is that they do not get over fat. It is always in New Zealand to produce heavy lambs without getting it too fat.

According to Harry, with Oxford Downs they would expect to get up to the weight and will not get over fat. They will still get up to 18 kg which is acceptable. He remarked:

> We put the weight on with some traditional breeds but they are not leaner. You get 18-20 kg but still going over fat when you go to the works.

Farmers also considered that Oxford Downs could produce more wool compared to other black-faced sheep breeds such as Suffolk and Dorset Down. They considered this is an added advantage for them. Philip and Gerald also took this aspect into account when they adopted Oxford Downs. Philip, a 31-year-old commercial farmer, said:

> I regard Oxford Downs as an opening to put across to my Romney and Corriedale and to give us early fattening and low GR for pre-Christmas and early market. They also have the advantage of being able to grow quite a bit of wool. Therefore, they can make the whole lamb today with a lot more profit gain; whereas the ordinary breeds such as Suffolk and Dorset Down can only grow a small amount of wool.

Gerald, a 40-year-old stud breeder who also produces prime lambs from his farm, has also Suffolk and Romney in his property. He remarked:

> In fact the Oxford Down is one of the highest and best yielding black-faced wool breeds for wool production. As wool is sold at very much the same price as Romney so in fact it's got quite a potential there.

Some farmers also indicated that they considered the black-faced sheep (Oxford) over the white-faced sheep (Texel) for ease of lamb drafting especially when they have a traditional white-faced sheep in their commercial flock. Gerald and Harry also included this aspect in their decision to adopt Oxford Downs. As Gerald put it:

> The other reason why we decided to put Oxford Downs as against Texels or Finns because it is a big advantage to have a black-faced sheep when you want to sort the sheep for sale. Because if it is a white face sheep and the Romney is also white face and if it is a 50-50 flock sheep it will be very hard to pick out from a flock of say 2,000-3,000 sheep. It is very hard to pick up the one you want. If you have the black face then it will be very obvious. There is no mistake. You have the black face clearly standing out and the drafting gate can sort them out. There is no risk of fibre contamination of the main flock.

When asked how did he make sure that there is no fibre contamination in his farm Gerald answered:

> When it comes to shearing time, we shear our Romney and all that wool are sold as pure Romney wool and the black-faced sheep are shorn separately. They will be done after shearing of the Romney have completed. There is no risk of the black fibre contamination. In fact most of the time the shearing dates are different because they have different wool growth rate. Black-faced sheep generally does not grow wool very quickly.

Gerald mentioned that if they did not sort them out they would end up introducing something like 30 per cent cross into their flock which would downgrade their Romney or Coopworth or whatever is the main breeding line. Similarly, Harry also argued that black-faced sheep would also help to make lamb drafting much easier. He said he has a white-faced sheep, Corriedale, in his flock and when it comes to drafting the animal it could be either Corriedale or black-faced sheep. He said in this way the lamb drafter could easily identify the animals which he wanted and would make no mistakes in the selection.

Some farmers also mentioned that they there was a big demand for the black-faced sheep for fat lamb production. They considered that the lamb price was also very high. Those farmers who have the wool-breed sheep such as Romney considered that introducing Oxford Downs would be an ideal strategy of diversifying their farming operations. Gerald put it this way when describing his farm diversification strategy in relation to introducing Oxford Downs in his farm:

> The wool market becomes more and more uncertain and eventually collapse. We can't depend on our Romney. At the back of our mind we have to make the decision to diversify our income immediately. There is a big demand for the black-faced sheep to grow fat lambs now that the lamb price is very high. So we make the decision to consider the Oxford Down for the fat lambs production in addition to our recently introduced Suffolk, also a black-faced sheep.

A few farmers also indicated that the physical appearance of the sheep also plays a very important aspect in their decision to adopt the new breeds. They looked into the size and

conformation of the sheep breeds. For example, Philip regarded this aspect as one of his major factors in the decision to consider Oxford Downs:

> I just looked at Oxford Downs and Texels. I saw Texels at the Edinburgh Rural Show in Scotland in 1990. I looked at the size and conformation of Texels in Europe. In Europe Texels have lost a lot of conformation. They are going in different direction and have different sizes. They have small and large Texels. So there is no real true Texels. The Oxford Down is still true to type as far as the breed is concerned. This was one of the major factors in my decision to consider Oxford Downs.

It was shown that some farmers had made their decisions to adopt the Oxford Down breeds if there was a need to introduce the characteristic of faster growth rate into their flock. If they passed this criterion the model predicted that they would adopt the Oxford Down breeds. Other attributes of the breeds that were also taken into consideration were: lean meat, wool fleece weight, easy drafting, good demand and true to type. There are six farmers who have decided to adopt Oxford Downs.

In summary, the results showed that genetic factor was a key decision issue in the decision to adopt or reject the new sheep breeds. It was revealed in the decision tree that those farmers who believed that the new sheep breeds could improve the genetic merits of their stock and expect to produce financial returns did not necessarily make their final decisions to adopt the breeds. They decided not to adopt the breeds because of certain constraints such as time, ram availability and its cost. Those who did not have these constraints had made their decisions to adopt the breeds. The results also showed that the descriptions of the new breeds of sheep as expressed by farmers seemed to match those described by the scientists. They would adopt Finns if they thought that there was a need to increase fertility in their flock. They would adopt Texels if they thought there was a need for more leanness and muscling in their stock. They would adopt Oxford Downs if there was a need to introduce the attribute of faster growth rates in their flock.

However, not all farmers were receptive to the new breeds. A few farmers had decided to reject them. The next section describes the criteria used by farmers in their decisions not to adopt the new sheep breeds. It also describes the attributes of the breeds from the non-adopters' point of view.

6.5 Decisions not to Adopt Exotic Sheep Breeds

This section describes the main reasons why some farmers rejected the new breeds. First, they did not believe in genetic improvement (criterion 1), "Do you believe that exotic sheep breeds can improve the genetic merit of your stock?". Second, although they had indicated that they believed in genetic improvement, they were constrained with time (criterion 2), "Do you have time to manage the new breed with the existing workload that you have on your farm?", rams availability (criterion 3), "Do you believe that there is not enough purebred rams available which is a major reason for not adopting exotics?" and its cost (criterion 4), "Do you believe that the cost of exotic rams is too expensive so that you do not wish to invest in exotics?" Other factors associated with rejection of the new breeds were export restrictions (criterion 7), "Do you export rams to Australia as your reason for not adopting exotics?", health risk (criterion 6), "Do you believe that the new sheep breeds will pose a health risk to your present stock?" A summary of the reasons for farmers to reject the breeds will be placed at the end of the section.

6.5.1 Disbelief in Genetic Improvement

Genetic improvement is a key decision issue in the decisions to reject the new sheep breeds. As shown in Figure 8, some farmers made the decision to reject the new breeds because they did not believe that the exotic sheep breeds could improve the genetic merits of their stock (criterion 1).

Other factors mentioned were: export restriction and health risk. A few farmers had also indicated that they would continue to reject while others preferred to have a "wait and see attitude".

There were eleven farmers who did not believe that the new breeds could improve the genetic merits of their stock (criterion 1), "Do you believe that exotic sheep breeds can improve the genetic merit of your stock?" They were all aware of the information and knowledge about the breeds from various information sources. However, they argued that information or data available from various information sources such as results obtained from local trials or overseas concerning the breeds did not provide sufficient evidence to show that the exotics were better or superior than their conventional breeds. They argued that they did not see enough facts or figures to convince them that the new breeds were better than their existing breeds. For example, farmers claimed that there was not enough data to convince them that Texels would produce superior lamb carcasses or Oxford Downs have faster growth rates and suit the dry land areas or Finns have high lambing percentage and suit the hill country areas. They said that they wanted to see some results from comparative trials or research between exotics and the traditional breeds to show their differences and how they could get the benefits from using the new breeds. According to the farmers these results were not available to them. The non-adopters claimed that with the information available to them they did not see any financial benefits from the attributes of the new sheep breeds. As such they said that they would not consider any change.

(a) Export Restriction

One of the factors associated with disbelief in genetic improvement in rejecting the new breeds was on the export restriction of the traditional rams to Australia (criterion 7), "Do you export rams to Australia as your reason for not adopting exotics?" A few farmers would not adopt the

new breeds if their presence on their property was not compatible with their existing farming objectives such as restricting them from exporting rams to Australia. If farmers met this constraint, the model predicted that farmers will not adopt exotics.

There were three farmers who met this constraint and did not adopt exotic sheep. They were exporting traditional sheep rams (e.g., Poll Dorset) to Australia. This economic activity contributes one of their sources of income. When exporting animals to Australia farmers have to follow the quarantine regulations of the Australian government. According to them, one of the requirements under the Australian quarantine regulation was that they were not allowed to introduce any exotics in their property if they were to proceed with their rams trading programme with Australia. Australian buyers would not accept any rams from farmers in New Zealand who have introduced exotics on their farms. In the interview farmers explained that since they could see the financial benefits from selling their animals to Australia they decided not to adopt the new breeds. For example, Leo, a 39-year-old stud breeder, put it this way when explaining his reasons for not introducing exotic sheep in his property:

> The other reason is that I am selling my stud rams to Australia. The Australian quarantine regulation does not allow you to introduce any exotics in your property. They are afraid of disease such as scrapie. If I have exotics in my property then I would no longer be able to sell my sheep to Australia. I could not afford, economically, to lose these sales there. Some I deal directly; others I take the rams to Australia and sell them at the agricultural show.

Similarly, Brian and Samuel were also exporting some of their local rams to Australia in addition to selling them locally. They indicated that they have established their good contacts with buyers in Australia. They have to abide by the rules and regulations of the importing country. As Brian, a 44-year-old stud breeder, put it:

> The main reason why we cannot have Texels or other exotics in this property is because we are having a business deal with our counterparts

> in Australia. One of the custom declarations is that we must not have any exotics in our property. We export products and Poll Dorset rams to Australia. Well, it is not a very large thing but in monetary terms it is quite substantial. We are exporting our top stud rams to Australia.

These farmers did not think that it was a good idea to introduce change in their farming systems at the moment. They said they were still happy with the returns they have from the sales of their rams. They argued that with the information available about the breeds they did not believe that there was a need for change. According to them, it was still a doubtful to them how the exotic sheep could fit into the New Zealand sheep industry. Farmers for whom this constraint applies do not go on to consider other aspects of this tree and exit at this point.

(b) Health Risk

Another factor associated with disbelief in genetic improvement for rejecting the new breeds as mentioned by farmers was because of the health risk involved (criterion 8), "Do you believe that the new sheep breeds will pose a health risk to your present stock?" Farmers would also not adopt the new breeds if they thought that the new breeds would pose a health risk to their present stock. If farmers met this constraint, the model predicted that they would be eliminated earlier from the decision tree and would not adopt exotics. There was one farmer who failed this criterion and therefore did not adopt exotics. The exotic sheep were brought into the country in the form of embryos and semen. They went through artificial insemination and embryonic transfer and the progeny were kept in quarantine for about five years. In the interview one farmer claimed that certain company was importing some sheep into the country live. He argued that even though the sheep were put in quarantine for five years he was still sceptical on their security and worried that these new breeds of sheep would still be able to carry foreign disease and spread to his present stock. As such he did not want to adopt the new breeds. Kevin, a 63-year-old stud

breeder who also produces commercial prime lambs, explained:

> The main reason why I do not want any new exotic sheep breeds in my property is on health aspect. This is my number one reason. I do not want them to jeopardize my stock here. I would not play with exotics at this stage. They said the animals were brought in the form of embryos and semen. But then some of the animals were brought in live and placed in quarantine. I would not think the exotics will play a major part in the meat industry in New Zealand. The exotics have to prove themselves to be free from any unwanted disease such as scrapie and to produce good lambs on the ground for the farmers to see, without too much assistance. We do not have enough results yet to prove all that.

Most farmers believed that the exotics were free from any disease, because of the strict quarantine procedures. Those farmers who believed that the exotics were free from any disease decided to try the new breeds.

(c) Continued Rejection

From the interviews, it was also found that five farmers were found to be adamant about the new breeds. They indicated that they did not believe that the new breeds could improve the genetic merit of their stocks and would continue to reject the new breeds (criterion 9), "Will you ever consider exotics in future?" All of them were not involved in exporting rams to Australia, and believed that the new breeds did not pose any health risk to their present stock.

A few farmers still maintained that their own breeds were superior in terms of: (1) their adaptability to climate and physical features of the area, (2) good attributes such as lambing percentage, wool and meat quality, (3) good demands for the rams, and (4) good financial returns. Some farmers stated that they have been breeding and farming their breeds for generations and have dedicated their life trying to improve their breeds. They said that they have all the records and observed that their traditional breeds have performed reasonably well under the climatic and

physical conditions of their areas. They were still very happy with the performance and the attributes of their local sheep. Hillary, John, Michael, Neil and Dennis indicated that they did not believe that the exotic sheep could improve their genetic stock and would never consider the new sheep breeds in their farms. For example, John, a 47-year-old Corriedale stud breeder who also produces commercial lambs, had this to say about his traditional breed:

> We have been breeding Corriedale sheep since 1927. We are traditional Corriedale breeder. I have taken a lot of interest in sheep and have dedicated my life trying to make them better. This is my main interest in life apart for my family ..... In the Corriedale breed we try to get some half way between. This is a dual-purpose sheep producing wool and meat. We like to have a what we call "leg in its corner". Our Corriedales have been performing exceptionally well under our local climatic and soil conditions. I do not believe that any other breed that would be as good year in and year out as Corriedale.

Michael, Hillary and Dennis were commercial farmers and have the same type of sheep breed as John. They also mentioned that Corriedales have performed satisfactorily in their property. They have observed that their sheep have adapted themselves to adverse conditions in their areas such as climate, pasture and soil. As Hillary, a 30-year-old commercial farmer, remarked:

> This area has always been Corriedales. The main reasons are because they are dual-purpose, suited to the climatic and terrain in this area. If we have Corriedales we are spreading our income. It can be a lamb market and also a kind of wool market. With a dual purpose breed you got two options rather than one. Also we have a hot dry summer and hard winter here. The Corriedales suit the type of climate we have here. We have stress time over summer and the feed level is low. Other types of breed can't stand these sort of conditions. The terrain in this country is very steep. Corriedale is a very hardy type of sheep. They are good climbers and just suited this country.

Neil and John were among the prominent stud breeders in their areas. According to them, the other aspect about their sheep was that they have a good market for their rams. They mentioned that they still have good response from their clients for their stud rams. Their clients are mostly those having the same farming objectives, climate and land physical features. They said that they

would not change until the demand from their clients changes. As Neil, a 37-year-old stud breeder, put it:

> We prefer to stick to our traditional breeds because the demand or market is good at the moment. Until such time when we produce something that we can't sell, only then we think about changing. Once we found that we are losing our clients then perhaps we may consider the exotics in future. The local farmers here are very traditional and to get them to change to something else, it's going to be hard.

Regarding the good attributes of exotic sheep as mentioned by the promoters Neil remarked:

> They said Texels have good meat yield, Oxford Down has faster growth rate and Finns have high lambing percentage. I don't need that. My Dorset Down and Romney have proved to perform very well under our climate and the sort of terrain that we have on this farm. Our clients have the same land features that we have here and they are very happy with what we produce here.

(d) "Wait and See"

However, they were two farmers who maintained some reservations about the exotic sheep even though they did not believe that the new breeds could improve the genetic merit of the stock (criterion 9), "Will you ever consider exotics in future?" Even though they thought that the exotic sheep could not improve their genetic stock, they preferred to keep their open mind about the new animals. They said that even though they did not adopt now they might think about the exotics positively in future. For example Noel, a 42-year-old commercial farmer, remarked:

> I am trying to keep an open mind because the farmers have to be prepared to move with time and to keep up with modern technology... But at the same time I am a little bit cautious. The new breeds sound very good. For example, they said Oxford Downs have faster growth rates. But we are doing very well with our Suffolk. So I prefer to stay back and to wait and see what will happen.

6.5.2 Constraints

Some farmers were influenced by certain constraints for rejecting the new sheep breeds. There were three farmers who believed that the new breeds could improve the genetic merits of their stock and expect to produce financial returns. However, because of some constraints they decided to reject the breeds. This section describes three constraints which influenced farmers rejecting the new breeds. These constraints were time limitation, ram availability and cost, and will be discussed in turn.

(a) Time

The first constraint associated with the non-adoption of the sheep breeds is the time limitation. In the interview one farmer pointed out that his main reason for rejecting exotics was because of the time constraint (criterion 2), "Do you have time to manage the new breed with the existing workload that you have on your farm?" He said that he was practising diversification programmes in his farming systems. He was a stud breeder, commercial farmer and also planting some crops on their farms. He said that he has thought about the new breeds and how they could fit them into their farming objectives. However, after considering the time factor and the expected benefits from the investment if he were to introduce exotics, he decided to drop his original plan to introduce exotics. For example, Christopher, a 40-year-old stud breeder-cum-commercial farmer had thought about Texels or Oxford Downs but later changed his mind and not to adopt. He said:

> We have thought about either Texels or Oxford Downs but not the Finns because we do not have any lambing problem here. We looked at our resources available to run our farm. We do not have sufficient time and labour to manage the new breed. We are quite happy with the number and type of breeds, and the crops and cattle that we have now. We feel that our Suffolk and Romney studs can do the jobs. The present system has taken a lot of our time and labour especially the stud programme. So we thought there is no point to have additional breeds if you do not have

> time to look after them properly...You have to think of the returns because exotics are very expensive for us.

(b) Ram Availability

The second constraint which limits the adoption of the breeds is the availability of the purebred rams. In the interview one farmer explained that his main reason for rejecting the new breeds was because there was not enough purebreds available for sale even though he believed that the new breeds could improve the genetic merits of the stock and that time was not a limiting factor (criterion 3), "Do you believe that there is not enough purebred rams available which is a major reason for not adopting exotics?" He said that he only wanted to get a good quality purebreds and not the halfbred, three-quarter and seven-eighth breeds. He stated that there were mainly halfbred rams available especially those from Sheepac. Robert, a 35-year-old commercial farmer, had this to say about the new breeds:

> I have thought about Texels. I would like to get a reasonably good purebred Texels rather than the halfbred or three quarter breeds. But there was not enough reasonably good purebreds available for sale. Finally, I made up my decision and preferred to remain with my Corriedales in my farm. I am very happy with them.

Robert's argument was supported by some of the adopters who also mentioned that there was not enough purebreds available. They indicated that they would like to purchase more of the purebreds such as Texel rams to increase the number for breeding purposes. Bob, an agricultural consultant from Sheepac also agreed that Sheepac did not produce and sell many purebred rams to the farmers. According to him the time factor did not permit them to produce more of the purebred rams for sale. Therefore, there were not many of the purebreds on the ground. A lot of them were halfbreds. He said:

> We were only concentrating on breeding halfbreds, even though there

> were few purebreds available. Basically all the animals on the farms now are having very high percentage of halfs, so you are getting quarter Texels. As soon as farmers start producing a lot of purebred Texels and putting them over, we are going to get half Texels and that's when you really start to get the most of it. I would say that out of that 26 per cent of exotics already on the ground you probably find 1-2 per cent pure Texel being used there.

(c) Cost

The third constraint is the cost factor. In the interview one farmer stated that his main reason of rejecting the new breeds was because he regarded the cost to procure the new breeds was unreasonably high (criterion 4), "Do you believe that the cost of exotic rams is too expensive so that you do not wish to invest in exotics?" He believed that the new breeds could improve the genetic merits of the stock and that he had no constraint of time and ram availability. He explained that with the downturn in the prices of wool it would mean a very tight budget for the average size farmers but he did not indicate that lack of capital was a reason for not purchasing. He was not very happy at all on the prices quoted by the promoters. The prices quoted for purebred Texel ram was between $2,500 and $10,000; Oxford Downs was between $1,500 and $5,000, and Finns was between $1,000 and $2,500 per head. Philip, a 40-year-old commercial farmer had planned to purchase Texel rams but according to him the price was unreasonably high. He said that it was too expensive and thought that it might not pay him to introduce the new animals. He said:

> We have our plan to buy the Texel rams. But the price quoted by the company was unreasonably high. It was too expensive: it was very unrealistic. Since we do not have enough information or data to convince us that the breeds are better than our traditional breeds and we are not sure of their performance and the returns we can get from the investment, so we thought it's best to drop our original plan.

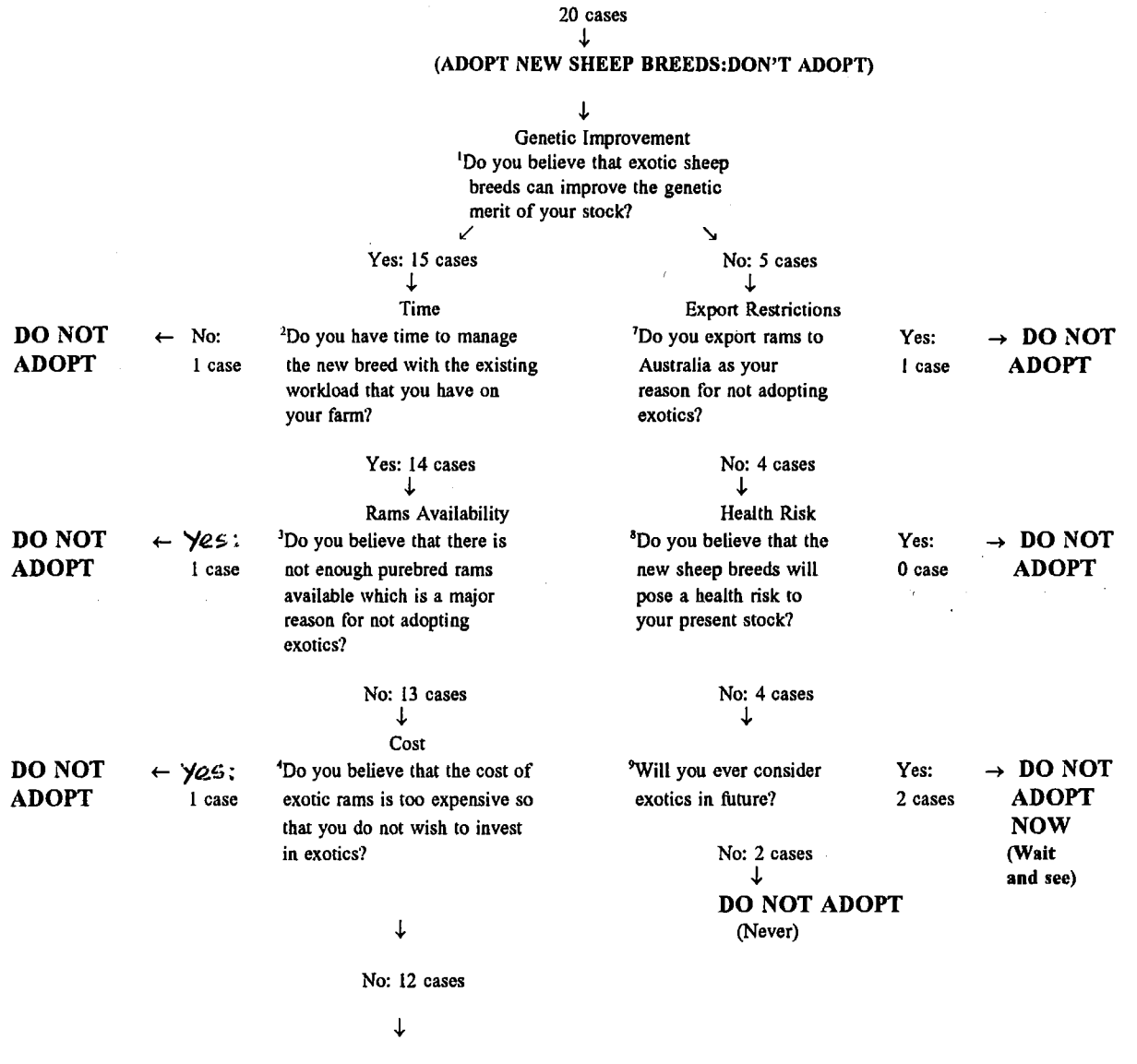
In fact, Harry, a 28-year-old commercial farmer, had decided to purchase Oxford Downs instead of Texels because the price of the latter was too expensive. According to Harry his situation was a toss up between Oxford Downs and Texels. He said:

> I had $29,000 and used that whole amount to buy 16 Oxford Downs. If I had spent that same amount of money on Texels I would only be able to purchase five or six Texels. But then I also think of my area here which I believe more suited to Oxford Downs. Therefore, I decided to proceed with Oxford Downs.

This section has described the main reasons for farmers who have decided to reject the exotic sheep breeds. It has identified the main criteria used by some farmers in their decisions to reject the breeds. Some farmers did not adopt the new sheep breeds because they did not believe that the new breeds could improve the genetic merits of their stock. Other factors associated with disbelief on genetic improvement were export restrictions and health risk. There were some who believed that the new breeds could improve the genetic merits of their stock but because of the constraints of time, ram availability and its cost had decided not to adopt. The results showed that some non-adopters did not agree to those descriptions or attributes of the new breeds of sheep as revealed by the scientists. Those who did not agree or believe in the claimed merits of the new breeds had decided to reject the breeds. But those who agreed or believed in the claimed merits of the breeds as revealed by the scientists had also finally decided not to adopt because of certain constraints. There were 14 farmers who had decided not to adopt the new breeds because of the two main reasons as stated above.

6.6 Model Testing

The model was tested against a new sample of 20 farmers consisting of 12 adopters and eight non-adopters (Figure 9). That is, those who had been interviewed for building the decision model



Note: Footnote to denote the decision criterion

Figure 9: Test of Farmers' Decisions to Adopt the New Sheep Breeds

would not be interviewed during the testing stage. Each node or decision criterion in a model was a question in the questionnaire. There was no change in the decision criteria during the interview. The error was identified and the percentage predictability was then calculated. The decision model had one error and therefore gave a success rate of 95 per cent out of 20 cases taken. The main error in the model was found in the specification of the criterion for the new sheep breeds. The farmer wrongly specified leanness and muscling criterion and the tree predicts that he would adopt the Texel breed. But in fact he introduced Oxford Down in his farm.

6.7 Summary of Results

In this chapter, the farmers' sources of information about the new breeds of sheep were described. All farmers interviewed were aware of the information about the new breeds. They obtained information about the breeds from various information sources. The decision tree had successfully identified the main criteria used by farmers in their decisions whether to adopt or reject the new breeds. The results showed that those farmers who believed that the new breeds of sheep could improve the genetic merits of their stock and expect to produce financial returns and did not have the constraints of time, ram availability and its cost would adopt the new breeds of sheep. Those who did not believe that the new breeds could improve the genetic merits of the stock would not adopt the new breeds. Other factors associated with disbelief in genetic improvement were export restrictions and health risk. And there were some who had indicated that they would never consider the new breeds while others had expressed their reservations and adopted a wait and see attitude. Furthermore, although few farmers had indicated their belief in genetic improvement they did not adopt because of the constraints of time, ram availability and its cost. The decisions to adopt a particular breed would depend on farmers' needs or preferences in relation to their farm problems. Generally, they would need a breed that would provide a certain attribute which

could help solve their farms' problems. There were also other secondary attributes associated with the new breeds that were mentioned by the farmers. The adopters of the new sheep breeds had also given the characteristics of the breeds similar with those revealed by the scientists; but the non-adopters had shown different descriptions and opinions. When the decision model was tested against another set of informants, it gave a predictability of 95 per cent.

CHAPTER 7

DISCUSSION AND CONCLUSIONS

7.1 Introduction

This chapter presents a summary of the research findings and discussion. It also states some research limitations, suggestions for future research and the conclusion which can be drawn from the study. The chapter begins by giving a summary of the major aspects associated with decision making and adoption which have been described in the preceding chapters.

7.2 Decision Making and Adoption

The new sheep breeds were brought into the country in order to widen the genetic base of the national flock: Texels for leanness and muscling; Oxford Downs for faster growth rates, and Finns for high fertility. What were the reactions of the farmers toward the new breeds? The result from a survey by MAF on the use of the exotic sheep by farmers in Canterbury showed that about 26 per cent of the farmers were using the new breeds. The objectives of this research were (1) to identify the main factors or reasons that influenced farmers in deciding to adopt the new sheep breeds, and (2) to identify the limiting factors that influenced farmers to reject the new breeds. The main criteria used by farmers whether to adopt or reject the new breeds were also specified. Some scientists have given descriptions of the main attributes of the new sheep breeds. While some farmers have shown a positive response towards these attributes, others decided to reject them.

Some common decision models were reviewed to describe decision making by farmers but all have shortcomings in terms of explaining the actual decision making from farmers' perspectives. For example, the concept of innovativeness in the diffusion theory has not been able to explain clearly the reasons for adoption or non-adoption of an innovation. Similarly, some researchers have also expressed reservations on the validity of economic models or the expected utility models in the actual practice at the farm level. This research uses an alternative approach to decision making called the ethnographic decision tree modelling. The model helps to understand the actual farmers' decision making in terms of specifying the main decision criteria in their decisions whether to adopt or reject the new breeds of sheep. This type of approach in understanding farmers' decision making is not commonly used in farm management research to date and is an alternative approach which can offer real advantages over the traditional approaches.

7.3 Summary of Results

This section gives a summary of the research findings regarding a model of farmers' decisions to adopt the new sheep breeds. It summarizes the main reasons or criteria used by farmers in their decisions whether to adopt or reject the new breeds.

The results of this research showed that all the farmers interviewed were aware of the information about the new breeds. They obtained information about the breeds from various information sources. The main sources of information were: field days, information brochures and the *New Zealand Farmer*. Other sources of information would include personal contact with Sheepac and LambXL, friends, meeting/seminar, the *Press*, overseas trip, demonstration farms and discussion group.

Farmers had stated their own reasons or criteria in the decisions whether to adopt or reject the new sheep breeds. These main reasons or criteria were presented in the form of a decision tree. It was found that genetic improvement was a key decision issue in farmers' decisions to adopt or reject the new breeds. The results showed that those farmers who believed that the new breeds could improve the genetic merits of their stock and expect to produce financial returns and did not have the constraints of time, ram availability and its cost would adopt the new sheep breeds. Those who did not believe that the new breeds could improve the genetic merits of their stock would not adopt. Other factors associated with disbelief in genetic improvement were export restrictions and health risk. While there was a few who maintained that they would never adopt the new breeds, others would prefer to keep an open mind about the breeds and indicated that they might consider in future. Furthermore, although few farmers had indicated their belief in genetic improvement they did not adopt because of the constraints of time, ram availability and its cost.

The model was tested against another sample of 20 farmers and gave a percentage predictability of 95 per cent.

7.4 Discussion

The following discussion will focus on the interpretation of the research findings in terms of existing literature regarding decision making in the adoption of certain innovation. The discussion begins with the issue of rationalization for rejecting or adopting the new sheep breeds.

In the decisions to reject the new breeds of sheep, farmers have stated a range of reasons. First, they said that the information available regarding the new breeds were unreliable and did not

believe that the breeds could improve the genetic merits of their stock or would lead to economic profitability. A few indicated that export restriction and health risk were also reasons for non-adoption. Second, there was also a group of non-adopters who have shown to believe that the new breeds could improve the genetic merits of the stock, but did not try the breeds because of the constraints of time, ram availability and its cost.

From the farmers' point of view, it makes sense for them not to adopt the new breeds. This shows that farmers are acting rationally when they made the decisions not to adopt the breeds. Similarly, from the viewpoint of the adopters it also makes sense for them to try the new breeds. They said that the information regarding the new breeds was reliable and believed that the breeds could improve the genetic merits of the stock. They expected that the new breeds would lead to economic profitability. The results, therefore, showed that there is reason to suggest that a rationalization issue is an important factor in the decisions for the farmers to reject the new sheep breeds. Vanclay (1992), in his overview of the issues regarding the barriers to adoption of agricultural innovation, mentioned that failure to adopt has been proven to be objectively rational for the farmer. He said that farmers are acting rationally when they do not adopt technologies that are not divisible. Similarly, Fairweather (1992) in his research related to farmers' decisions to plant trees also showed that farmers in his study acted rationally in their justifications not to plant trees. The results also showed that, because of rationalization issue, there is no evidence to suggest that non-adopters are backward as implied by Rogers (1983).

In the interviews the non-adopters mentioned that they would like to see proper research or trials in order to provide them evidence to prove to them that the new breeds were superior than their conventional breeds. They wanted to see more facts and figures to convince them that the new breeds could lead to economic profitability before accepting any change. Perhaps since some of

these farmers rationalized their preference not to adopt by invoking "problems" with the new breeds, they do not genuinely want to see research that would suggest that they change their policy. Therefore, with the process of rationalization as an important issue in farmers' decision making, one could see that even if proper research were to be carried out and positive results were available one could not guarantee that more farmers would change and adopt.

Previous studies have shown that one of the factors that influences the rate of adoption is economic profitability (Rogers, 1983; Kivlin and Fliegel, 1968). In this research the decisions made by the adopters by deciding to adopt the new breeds are also associated with economic profitability. The results reported here as shown in the decision tree did not give any explicit recognition to financial factors. However, in the interviews the adopters perceived that the attributes of the new sheep breeds would be expected to lead to economic profitability. They argued that if the new breeds could improve the genetic merits of their stock this would mean that they would expect to receive financial gains from the breeds. But, the decision tree only specified the main decision criteria elicited during the interview which were used by the farmers in their decision making.

The decision tree reveals that farmers would have to consider the reliability of the information about the attributes of the new sheep breeds in their decisions whether or not to adopt the new breeds. Those who did not believe that the new breeds could improve the genetic merits of the stock would not adopt the breeds. But those who believed that the breeds could improve the genetic merits of the stock and later would lead to economic profitability did not necessarily proceed to adopt the breeds. They were subjected to certain constraints such as time, ram availability and its cost. As seen from the tree, some farmers would not adopt the breeds if any one of these constraints was important to them although they believed that the new breeds could

improve the genetic merits of the stock. Those who believed that the breeds could improve the genetic merits of the stock and did not have the constraints would make the decisions to adopt the new breeds.

It is necessary to explain that in the interviews farmers had indicated that in their decisions to adopt the new breeds or a particular type of breeds they took into account their farming objectives, problems and needs. Although these aspects do not appear in the decision tree they were reflected by the main criterion of a particular breed. Therefore, it is shown that the farmers would go through the decision tree and subjected to certain criteria or constraints when they decided to adopt or reject the new breeds or choose a particular breed of sheep. As stated by Gladwin (1989c), a decision tree is a sequence of discrete decision criteria, all of which have to be passed along a path to a particular outcome or choice.

The fact that more than 23 per cent of the adopters are using Texels may indicate that the overfatness problem is more critical to some farmers compared to lower lambing percentage and growth rates although this cannot be concluded from this study. It could be possible that some farmers are more concerned about producing leaner lambs and expecting long-term financial return. There are not many farmers who have gone for either Oxford Downs or Finns compared to Texels. But this does not mean that these attributes of high fertility and faster growth rates are not important because the adopters of Finns and Oxford Downs have shown to act rationally in their decisions to adopt. Therefore, from the viewpoint of farmers there are reasons to suggest that the sheep industry has lacked the attributes of leanness and muscling, faster growth rates and high lambing percentage, and that farmers would anticipate financial benefits from adopting the new breeds in future. These perceptions of the new breeds by the farmers suggest that farmers support the views from some animal breeding scientists who indicated that the national flock in

the country has narrow genetic base and lacked the attribute of leanness, fertility and faster growth rates (McMillan *et al.*, 1988; Galloway, 1993, pers. comm.).

There is also a need to look at the extent to which the farmers use the new breeds. Do the farmers use the breeds as terminal sires only or to change their ewe flock? From the interviews, the farmers indicated that the Texels and the Oxford Downs were both used as terminal sires over their traditional ewe flock. The Finns which were noted for their high fertility were ideal dams for cross breeding with terminal sires. The scientists have stated that the Finns were expected to be used in the hill country areas where the lambing percentage is found to be less than 100 per cent. They explained that too much Finn blood would reduce wool production but farmers would be expected to use about 25 per cent infusion of the genes which could result in an increased lamb drop of 25-30 per cent and wool production of 10-20 per cent lower than the base flock. But the scientists and the farmers also argued that high lambing percentage would be able to compensate for the decrease in the wool production. Thus, the farmers would still expect to receive long-term financial benefits from the breeds.

In previous studies, communication behaviour was often used to distinguish adopters and non-adopters or to describe the characteristics of the adopter categories (Fairgray, 1979; Rogers, 1983). In contrast, there was insufficient evidence in this research to support the existence of a significant relationship between communication behaviour and innovation adoption. In other words, there was no evidence to suggest that adopters had greater exposure to communication channels than non-adopters or farmers who acquired information from mass media or change agents had a higher rate of innovation adoption. In this research all farmers interviewed had indicated that they were all aware of the wide publicity regarding the new sheep breeds. The promoters utilized various forms of information sources to inform farmers what they should

expect from the new breeds.

Fairgray (1977), has shown that information sources played a significant role in farmers' decisions to adopt Perendale and Drysdale sheep breeds and the practice of growing maize in New Zealand. He indicates that when a potential adopter evaluates an innovation he seeks reliable information from sources of high trust and prestige. In this research there is no clear evidence to suggest that information sources played a very significant role in the decision to adopt the new breeds. Scientists believe that the new breeds of sheep have their attributes of widening the genetic base of the sheep industry, and would be a benefit to the farmers. However, farmers have different perceptions and interpretations of the new breeds. The meanings are with the farmers themselves. These meanings not only affect how they see their situation, but also how they respond to it and how this situation influences their future options (Blumer, 1969). The adopters may argue that the information from the various sources is reliable and credible and make their decisions to try the new breeds. But the non-adopters have their own ways of perceiving the information. They argue that the information available on the benefits of using the new breeds is not sufficient or not reliable to prove that they are superior than their traditional breeds and do not believe that the new breeds would expect to give them any financial gains. Therefore, as stated by Gladwin (1989c), in order to know why some farmers behave differently from each other in terms of decision making it is important to understand why they do what they traditionally do from their own perspectives.

A few farmers have revealed the importance of time, ram availability and its cost which constrained them in their decisions not to adopt the new breeds although they believed that the new breeds could improve the genetic merits of their stock. For example, a stud breeder who also produced commercial lambs and crops from his farm acted rationally when deciding to reject the

breeds because of the time constraint. According to Galloway (pers. comm. 1993) it is mandatory for all registered Texel Ram Breeders to keep records of performance of the Texel rams such as measurements of indexes that include ribeye, fat depth and growth rates. The New Zealand Texel Council has decided to set up a Sire Reference Scheme for progeny testing. This will enable ram breeders to compare the genetic merits of the individual sires. Such activities would therefore need a great deal of time from the stud breeders in addition to their existing activities on his farm. This finding, therefore, conforms with observations made by other researchers. Earlier findings had shown that lack of time, and labour and other factors associated with the aspects of the innovation also reduce or act as barriers to innovation adoption (Havens and Finn, 1975; Bandura, 1986; Fairweather, 1992; Vanclay, 1992).

Havens and Finn (1975), have shown that lack of capital was a determining factor in the adoption of an innovation. In this study, there was no evidence to suggest that the non-adopters of the new breeds of sheep were faced with capital constraint. The non-adopters consist of stud breeders and commercial farmers who own 150-2,900 hectares of land and 550-4,500 sheep. With these larger sizes of farms it is unlikely that capital would be a constraint. In the interviews farmers did not indicate that capital was a constraint to them in relation to the purchase of the new breeds. One can see that farmers tried to balance between the costs and the expected returns from the new sheep.

Some non-adopters have expressed their views that they would never adopt the new breeds. This shows that they still have a very strong inclination towards their own breeds because they could not find strong justification that the new breeds are better than their breeds. However, there are two non-adopters who have a "wait and see" attitude and might consider change if there is reason to believe that the new breeds are better and able to give more returns. Rogers (1983) indicates

that an individual can be subjected to continued rejection or later adoption of an innovation. According to Rogers, if the individuals still see no relative advantage from the innovation they will continue rejecting it. However, if they originally decided to reject the innovation, they may become exposed to pro-innovation messages, causing a state of dissonance that can be reduced by adoption. This is known as later adoption in the innovation-decision process.

Gladwin (1979a) in her case study of non-adoption of an agronomic recommendation concluded that farmers will not adopt an innovation or recommendation unless they have good reason to do so, and in order for them to adopt the innovation it must be demonstrably better than the existing situation. The decision tree has reflected this with its the main reasons for not adopting the new breeds.

Rogers (1983), in his diffusion theory, assumes that the non-adopters are less innovative, passive and resistant to change compared to the adopters. In this research there is no evidence to suggest that those non-adopters are less innovative, passive and resistant to change, or that the adopters of the new sheep breeds are more innovative and readily accept change. From the interviews, field observations and historical backgrounds of the farmers there is no evidence to differentiate between such category based on the degree of innovativeness. For example, a few of the adopters and non-adopters were traditional Corriedale farmers and there was no evidence to suggest that non-adopters were less innovative. Instead, they have expressed their reasons rationally why they did not want to adopt. This confirms research in the Third World countries, where Havens and Flinn (1975) showed that smallholder farmers were not able to adopt certain innovations because they were unable to obtain credit and not because they were passive or resistant to the new idea.

7.5 Research Limitations

Among the limitations of the study was the fact that the subjects were required to provide information on events which took place a few years earlier than the time of interview. It was possible that they could not recall or remember some of the facts or figures which would be essential for this research. For example, some could not remember: (1) the date, place of purchase and prices of the new breeds, (2) the frequency of attending the field days, meeting and seminar and the name of the organizers, and (3) the actual source of information about the exact sheep breed. These points were relevant in the decision model development and in identifying the various sources of information used by farmers regarding their decision whether to adopt or reject the new sheep breeds. However, this limitation was not likely to be unique in this study but one which is common to all methods used in research where one is asking for recollections.

Some scientists have argued that the sheep industry lacks fertility or has low lambing percentage, especially in the hill-country areas. As reported earlier there were less than one per cent of farmers in Canterbury who have introduced Finn on their farms. Unfortunately, in this study only three adopters of Finns were included: two were purely Finn stud breeders but only registered as breeders in 1991, and the other one was both involved in stud and commercial lambs production. The author had identified another Finns stud breeder as appearing in the Flock Book 1992 but was informed that the animals had been sold to someone else. Unfortunately, the author could not manage to identify the next buyer. Therefore, the viewpoints of Finns adopters regarding Finns may have been under-represented in this study because of difficulty in locating them.

One of the ways of getting the participants in this research had to be through informers. However, in some cases they were quite hesitant in revealing the names of other farmers, perhaps, for fear of intruding on their privacy. For example, some adopters had claimed that the other reason why some farmers were not interested in the new breeds was because they thought that the new breeds might result in the deterioration of the national wool clip. The author would have very much liked to interview these group of non-adopters but unfortunately was not able to get their names from the farmers.

In addition to the above issues, there is also a minor weakness with regard to using the decision tree method. The study focuses on decision making at one point in time and does not consider what will be the farmers' reactions in the future, say for a number of years. However, one could re-interview the informers in two or three years' time to check the stability of the decision criteria.

7.6 Suggestions for Future Research

As mentioned earlier, scientists argued that the sheep industry in New Zealand has shortcomings in terms of leanness, growth rates and fertility which were the main reasons for the importation of the new sheep breeds. This research has used a small and non-random sample of sheep farmers in Canterbury in order to specify the main reasons or criteria used by farmers in their decisions to adopt or reject the new breeds. From the viewpoint of the adopters of the new sheep breeds there is evidence to support the contentions by the scientists regarding these shortcomings. But these are the views of the sheep farmers in the Canterbury Region which do not reflect the entire sheep farmers' population in the country. The decision criteria which had been identified and tested in this study would provide the questionnaire for the study. It is, therefore, important to

undertake a bigger and random sample which is representative of the farm population as a whole. This will help to understand two important aspects: (1) whether the viewpoint of the scientists regarding the shortcomings of the sheep industry as revealed by the scientists match those of the whole farm population, and (2) to know precisely how the farmers are deciding to adopt or not to adopt the new sheep breeds.

It is also suggested that the method used in this research would also be relevant in other decision makings for other types of animals or agricultural decision makings. Gladwin (1989c) has cited various examples where this model has been used and tested such as farmers' adoption decisions, farmers' cropping decisions, marketing decisions and so on. According to Gladwin, where this method has been used, the predictability has been as high as 85-95 per cent of the historical choice data used to test the model.

7.7 Conclusion

The objectives of the study were to identify the main factors or reasons that influenced farmers in deciding whether to adopt or reject the new sheep breeds. The aim was to view the new sheep breeds through the eyes of the adopters and the non-adopters of the breeds, the sheep farmers. Rather than looking at the decision making from the economic or diffusion perspectives, the present study has presented a cognitive approach which takes into account the simplest ways farmers used in real life to make decisions concerning the adoption of agricultural innovations. This method is called Ethnographic Decision Tree Modelling.

To achieve these objectives, the study had focused on the decision-making processes of a small sample of 40 sheep farmers who had either adopted or rejected the new sheep breeds. It is

concluded that ethnographic decision tree modelling can be used to elicit the main criteria used by farmers in their actual decisions whether to adopt or reject agricultural innovations. These decision criteria are either specific aspects or constraints which the farmers used in their decision making processes from their point of view. These criteria are presented in the form of a decision tree. The decision model was also tested against another set of 20 informants and gave a predictability of 95 per cent.

Therefore, modelling of the decision process underpinning the farmers' traditions or learning why they do what they traditionally do is an alternative approach in understanding farmers' decision making in the adoption of agricultural innovations. The cognitive approach to decision making can help to identify the actual decision criteria and logic used by farmers in their real-world decisions.

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Appendix 1

18 January 1993

Dear Sir,

Mr Ngenang Jangu is an Agricultural Officer with the Department of Agriculture Sarawak, Malaysia. He is now on study leave doing a master's degree in Rural Extension at Lincoln University. He is attached to our Farm Management Department.

His specialist area is extension and rural development which involves in the transfer of new ideas and techniques to improve farming practices. His topic for his master's dissertation is farmer decision making regarding the adoption of new farm animals. He will be interviewing farmers in Canterbury to investigate some of the factors that influence farmers when they introduce new animals onto their farms.

Your name has been obtained from the Sheep Breeders Association New Zealand. Thank you very much for agreeing to be interviewed.

I would like to assure you that all information supplied will be kept strictly confidential and that you will never be associated with your responses.

The success of this interview such as this depends on the cooperation of the participating farmers. I would like to thank you in advance for the kind assistance I am sure you will provide.

Yours faithfully,

A.C.Bywater,
Professor of Farm Management,
FARM MANAGEMENT DEPARTMENT

Appendix 2: Model Testing - Questions on Farmers' Decisions Whether to Adopt or Reject the New Sheep Breeds

1.	Do you believe that exotic sheep breeds can improve the genetic merits of your stock?	Yes ___ No ___
2.	Do you have time to manage the new breed with the existing workload that you have on your farm?	Yes ___ No ___
3.	Do you believe that there is not enough purebred rams available which is a major reason for not adopting exotics?	Yes ___ No ___
4.	Do you believe that the cost of exotic rams is too expensive so that you do not wish to invest in exotics?	Yes ___ No ___
5.	Do you regard high fertility as the main reason to adopt exotics?	Yes ___ No ___
6.	Do you have more preference towards leanness and muscling than faster growth rates?	Yes ___ No ___
7.	Do you export rams to Australia as your reason for not adopting exotics?	Yes ___ No ___
8.	Do you believe that the new sheep breeds will pose a health risk to your present stock?	Yes ___ No ___
9.	Will you ever consider exotics in future?	Yes ___ No ___